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[Febru]ary 1989

Increased Efficiency of Sheep Production

Proceedings of the 1988 NC-111 Technical Committee

United States
Department of
Agriculture

**Agricultural
Research
Service**

Increased Efficiency of Sheep Production

Proceedings of the 1988 NC-111 Technical Committee

June 13-14, 1988 Denver, Colorado

Hosted by The Sheep Industry
Development Programs, Inc.

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AGENDA

NC-111 ANNUAL MEETING

STAPLETON PLAZA HOTEL, STAPLETON AIRPORT, DENVER, CO.

JUNE 13-16, 1988

Reservations: A block of rooms has been reserved for our use so reservations should be made at your earliest opportunity (303/321-3500).

Monday, June 13

Time	General Topic	Speaker, Location
PM		
1:00	Registration, $28	Stapleton Plaza Hotel
4:30	Reception	ASPC Office
6:30	Evening session	Stapleton Plaza Hotel
	Introduction	SID Host - Paul Rodgers
		NC-111 Administrative Advisor Kirklyn Kerr, Ohio
		CSRS Representative Steve Zobrisky, USDA
7:00	SID Program	Mike Caskey
7:30	IR-4 Program	M. C. Calhoun, Texas
8:00	Melatonin Update	A. L. Slyter, South Dakota and USDA, Dubois
8:30	The efficiency of young ram lambs	G. P. Lynch, USDA, Beltsville, MD.
9:00	Adjourn	

Tuesday, June 14

Station reports: Objective 1. Increase the efficiency of reproduction and growth in sheep.

Time	General Topic	Speaker
AM		
7:30	Late Registration, $28	
8:00	Agriculture Canada	Dave Heaney
8:20	California	G. E. Bradford
8:40	Idaho	C. R. Youngs
9:00	Illinois	D. L. Thomas
9:20	Minnesota	W. J. Boylan
9:40	Montana	P. J. Burfening
10:00	Break	
10:20	Missouri	D. H. Keisler
10:40	North Dakota	K. A. Ringwall
11:00	Oregon	H. H. Meyer
11:20	Texas	J. M. Shelton
11:40	Utah	L. G. McNeil

Tuesday, June 14 (Continued)

Time	General Topic	Speaker
PM		
12:00	Lunch	
1:00	Virginia	D. R. Notter
1:20	USDA, Dubois	Keith Ercanbrack
1:40	USDA, Jornada	Clarence Hulet
2:00	USDA, MARC	L. D. Young

Station reports: Objective 2. Develop feeding strategies for high producing sheep.

PM		
2:20	Indiana	R. E. Hudgens
2:40	Iowa	D. G. Morrical
3:00	Kansas	F. J. Schwulst
3:20	Kentucky	D. G. Ely
3:40	Break	
4:00	Minnesota	R. M. Jordan, H. F. Windels
4:20	North Dakota	D. O. Erickson
4:40	Ohio	K. E. McClure
5:00	Texas	M. C. Calhoun
5:20	USDA, Dubois	H. H. Glimp
5:40	Wisconsin	A. L. Pope, S. Lane

Evening program

PM		
6:30	NC-111 dinner	Stapleton Plaza
7:30	Business Meeting	
8:30	Open discussion New areas of research and possible areas of additional cooperative efforts.	

Wednesday, June 15

ASPC and NC-111 Mini-Symposium: Methods to Improve the Lean Yield of Lambs.

AM		
7:00	Walk-in registration, $70	Stapleton Plaza
8:00	Welcome	G. P. Lynch, NC-111 Technical Committee Increased Efficiency of Sheep Production
8:10	Meeting the challenge.	Rodger Wasson, American Sheep Producer's Council Denver, Colorado
8:45	Selection for lean lambs.	Gary L. Bennett Meat Animal Research Center Clay Center, Nebraska
9:30	Break	Stapleton Plaza

Wednesday, June 15 (Continued)

Time	General Topic	Speaker
10:00	Ultrasonics for live lamb and carcass evaluation.	J. R. Stouffer, Cornell Univ. Ithaca, New York
10:45	Trends in lamb processing.	R. A. Bowling, ConAgra Greeley, Colorado
11:30	Lunch	Stapleton Plaza
PM		
1:00	Anabolic agents - old and new for lean lamb production.	Harold W. Harpster Pennsylvania State University. University Park, Pennsylvania
1:45	Use of 2-Ketoisocaproate in growing lambs.	Steven Nissen Iowa State University
2:30	More lean, less fat with β-Agonists.	Joan H. Eisemann Meat Animal Research Center Clay Center, Nebraska
3:15	Break	Stapleton Plaza
3:30	Omega-3 Health Implications.	M. M. Mathias Colorado State University Fort Collins, Colorado
4:15	Relationship of muscle fiber types to the development of physiological maturity in meat animals.	M. B. Solomon, Beltsville Agriculture Research Center Beltsville, Maryland
5:00	Conference overview	C. F. Parker Ohio State University Columbus, Ohio

Thursday, June 16

AM		
7:00	Tour: Departs from the	Stapleton Plaza Hotel
	Warren Livestock Co.	Cheyenne, WY
	Lunch - Lamb barbeque	
	Lamb feed lots	Greeley, CO
	Research Facilities	CSU, Ft. Collins

This tour will be open to both NC-111 and Symposium participants by reservation. Reservations are limited so early reservation is suggested, cost $30 per person. Checks for registration and bus tour can be made out to SID-NC-111, address 200 Clayton Street, Denver, Colorado 80206.

ANNUAL REPORT OF COOPERATIVE REGIONAL PROJECTS

Supported by Allotments of the Regional Research Fund,
Hatch Act, as Amended August 11, 1955

January 1, 1988 to December 31, 1988

PROJECT: NC-111, Increased Efficiency of Sheep Production

COOPERATING AGENCIES AND PRINCIPAL LEADERS:

Regional Administrative Advisor, Ohio	K. Kerr
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HOST INSTITUTIONS & PAST & PRESENT OFFICERS OF NC-111 TECHNICAL COMMITTEE

Year	Host	Chairman	Vice-Chairman	Secretary
1972	U. of Illinois	---	No officers	---
1972-73	U. of Missouri	David Ames	A.B. Chapman	C. Parker
1973-74	Ohio State Univ.	David Ames	C. Parker	J.B. Outhouse
1974-75	Kansas State Univ.	C. Parker	J.B. Outhouse	Lowell Slyter
1975-76	Purdue University	J.B. Outhouse	L. Slyter	Joe Whiteman
1976-77	Oklahoma State Univ.	L. Slyter	J. Whiteman	Frank Hinds
1977-78	South Dakota St. Univ.	J. Whiteman	Frank Hinds	R.M. Jordan
1978-79	University of Kentucky	Frank Hinds	R.M. Jordan	Don Ely
1979-80	North Dakota St. Univ.	R.M. Jordan	Don Ely	Merle Light
1980-81	USMARC	Don Ely	Merle Light	G. Dickerson
1981-82	Ohio State Univ.	Merle Light	G. Dickerson	Dave Thomas
1982-83	Agriculture Canada Research Centre	G. Dickerson	Dave Thomas	E. Bradford
1983-84	Michigan State Univ.	Dave Thomas	E. Bradford	F. Schwulst
1984-85	Kansas State Univ.	E. Bradford	F. Schwulst	Dave Notter
1985-86	Univ. of Wisconsin	F. Schwulst	Dave Notter	Bill Boylan
1986-87	North Dakota St. Univ.	Dave Notter	Bill Boylan	Dave Heaney
1987-88	Sheep Industry Dev. Program, Inc.	Paul Lynch	Dave Heaney	Bob Hudgens
1988-89	Oregon State Univ.	Larry Young	Howard Meyer	Woody Lane

Progress of the Work and Principal Accomplishments

Eighteen states, four USDA and an Agricultural Canada experiment station officially participated in coordinated sheep research directed to the following objectives:

1. Increase the efficiency of reproduction and growth in sheep.
2. Develop feeding strategies for high-producing sheep.

Objective 1. The first year (1987) of a planned 2-year factorial experiment was to test the effects on early season breeding performance of: (1) Degree of isolation of ewes from the rams for 2 months prior to ram introduction, (2) Date of ram introduction (May 15, June 15 and (3) Location (breed: Davis Ramb x Finn-Dorest); Hopland (Targhee).

Essentially all ewes at the two locations were anestrus May 15, but there was a good induction and synchronization of estrus in both locations following ram introduction on that date. Degree of isolation did not appear to affect response. By June 15, many of the ewes at Davis and a few at Hopland had already ovulated spontaneously; the remainder responded well to ram introduction.

Booroola Merino-sired ewe lambs had greater ($P<.05$) ovulation rates (3.14 vs. 2.30) but similar numbers of lambs born per ewe lambing (1.82 vs. 1.80) compared to Finnsheep-sired ewe lambs.

Within the central ram test stations of Iowa, Wisconsin, Illinois, Indiana and Ohio, the 3 objective measures of gain on test, final off-test weight and ram birth type jointly accounted for 27-65% of the total variation in sale price of rams at public auction at the conclusion of the test, leaving a large proportion of the variation in price unaccounted for.

Assuming that the spider syndrome of Suffolk sheep is due to a single autosomal recessive gene and given the phenotypes and pedigrees of rams and ewes used in mating test conducted from 1985-87, 26.21 spider syndrome lambs were expected from 149 lambs born from 85 ewes. The observed number of spider syndrome lambs was 27, providing strong evidence that the condition is in fact due to a single autosomal recessive gene.

Work on the problem to find ways to reduce or eliminate seasonality of breeding in sheep is in progress. Preliminary data indicates that administering a 2 mg daily oral dose of melatonin does not hasten the onset of puberty in ram lambs. Other studies in progress are investigating melatonin's effect on IN VIVO progesterone production in cycling ewes. Melatonin implants may aid in out-of-season breeding although 74% of the control ewes also lambed.

A comparison of ewe breeds and breed crosses under farm and range flock conditions shows that Finn-Dorset-Targhee ewes produced .3-.7 more lambs per ewe lambing than Targhee ewes under either management systems.

A composite population of 50% Dorset, 25% Finnsheep and 25% Rambouillet shows a capacity for out-of-season lambing. Selection to extend the breeding season will begin in 1988. Acute ram introduction (ram effect) demonstrated that satisfactory spring breeding was contingent upon use of the ram effect. Ewes that were continuously exposed to vasectomized rams took six weeks longer to initiate breeding (August 31 vs July 17) than ewes that were isolated from and then re-exposed to rams.

A comparison of the prolificacy and productivity of crossbred Romanov-Targhee ewes with crossbred Finnish Landrace-Targhee ewes will be made. Crossbred ewes will be exposed to rams of the same breed. Ewe and progeny body weight, age at puberty, ovulation rate, litter size, rebreeding performance, and progeny postweaning growth rates and carcass merit will be recorded.

Studies of Booroola Merino and crosses have shown straight Rambouillet and Finn x Rambouillet ewe lambs weighed 54.5 kg at nine months compared with 43.2 kg for Booroola x Rambouillet crosses. Ovulation rates were 2.2, 1.6, and 1.4 for the Booroola cross, Finn cross and Rambouillet ewe lambs, respectively. Comparisons of Booroola Merino and Finnsheep continues at five stations with one station supplying the rams of

both breeds. Relative to Finn-crosses, Booroola crosses were superior for wool weight, ovulation rate and litter sizes at birth, inferior for lamb growth and puberty, and equal for birth weight, carcass merit and litter size at weaning.

The adaptability of four breeds to three different six-month breeding schedules has shown that conception rate and litter size are not affected by lactation if breeding occurs in the fall. However, in spring breeding, conception rate is greatly reduced for lactating ewes.

The quarantined Texel flock continued to expand in numbers. The development and growth of Texel-and Suffolk-sired lambs will be compared. Resistive impedance was evaluated as a rapid, noninvasive method to determine carcass composition.

Simulation research continued to investigate the relative effects of genetic changes in precocity, fertility, litter size born, livability, milk production, growth rate and body composition on biological and economic efficiency of sheep production systems.

Investigations on improving reproductive efficiency through steriod immunizaiton with Fecundin® (Glaxo, Australia) have produced a 30% increase in ovulation rate and an additional .2 lambs born per ewe treated. A range of genotypes responded similarly to immunization. However, trial work has revealed significant differences between genotypes in the success of producing two lambs following conception to twin ovulations. This difference is independent of immunization treatment.

The effect of day length on scrotal circumference and sperm showed that sequential 16-wk periods of long (16L:8D) then short (8L:16D) d gave scrotal circumference cycles of 210-220 d in rams. Percent of acrosome reacted sperm was 10-15% greater for rams in long light, and clumping of sperm heads in cervical mucus tests was prominent in ejaculates collected in long light. Phase shifting of cycles with light control to provide maximum testes circumference in February increased fertility in ewes mated in April about 25%. Fertility in ewe lambs bred in April at 7-8 m of age was increased from 5% to 58% by using a combination of 12-wk of long light (16D:8D) started 18 wk prior to breeding and 70 days of melatonin implants started 40 d prior to breeding.

The second year of breeding Rambouillet ewes in April following intensive selection on first year's performance resulted in 64.4% lambs weaned per ewe exposed--more than double the response to the first year's breeding.

Polificacy studies have shown after 4 years of intensive selection to offset recombination loss, ratios of inter se mated versus 1st generation 1/2 and 1/4 Finncrosses for lamb production are still slowly declining (.01 to .04 annually) but the rate of decline is decreasing.

Suffolk and Rambouillet milk traits were superior to Dorset and Targhee and Lincoln and Finn were the lowest. A heterosis affect (21%) was observed for milk production. Rambouillet had the highest amount of fat, Dorset the most protein and total solids were highest in the Rambouillet and Suffolk ewes.

Lambs (45-90 days of age) can be socially bonded to cattle in close confinement for 60 days. Bonded sheep stay close to cattle under free-ranging conditions resulting in increased protection from predators.

<u>Objective 2.</u> Polyether ionophores, monensin, lasalocid and lysocellin consistently improved feed efficiency. These ionophores also increased the accumulation of copper in the livers of sheep; however, the greatest response was observed with monensin. The response to monensin was great enough to reduce requirements for supplemental copper in marginally deficient diets and accentuate problems with chronic copper toxicity in diets containing excessive levels of copper. Evidence of monensin toxicity was observed at levels $\geq$ 55 mg of monensin/kg diet. Activities of the selenium-containing enzyme, glutathione peroxidase, were measured in blood collected from ewes and lambs at four ranches to assess the selenium (Se) status of sheep on the Edward's Plateau of Texas. Based on this criterion, there was no evidence of Se deficiency.

Forage studies with crossbred ewes fed either corn stover silage or ground corn cobs as basal feedstuffs during maintenance showed that initial ewe weights were 73.2 and 71.8 kg with an average body condition score of 3.1. After 104 days ewe weights were 69.4 and 66.4 with body condition scores of 3.3 and 3.1. Targhee ewes fed all-forage diets produced 1.97 lambs per ewe lambing with 50 day weaning weights of 15.2 kg.

St. Croix crossbred ewes were mated to rams of 3 sire breeds with the lambs compared in feedlot studies. Chilled carcass, loin and leg weights of Hampshire sired lambs were 20% larger and average daily gains 40% greater than St. Croix cross sired lambs. Performance and carcass characteristics of Rambouillet sired lambs were intermediate. Wool Se concentration was increased in lambs as inorganic Se was supplemented to 2.0 ppm compared to a corn-soybean meal basal diet (.073 ppm Se). Wool Se was higher when lambs were fed linseed meal compared to fish meal with each supplemented at .25 ppm. Lambs fed the basal diet were in negative Se balance. Lambs fed linseed meal and fish meal (.25 ppm Se) had urinary Se, Se retention and Se digestibilities similar to lambs fed .25 ppm Na_2SeO_3.

Feeding trials with lambs showed 376 gm body weight gain daily with a 5.24 feed/gain conversion with corn compared to 350 gm daily and 5.50 feed/gain conversion with barley feeding. Pelleting barley improved ($P<.05$) daily gains and feed/gain conversion more than pelleting corn.

Pelleted alfalfa and corn or peleted beet pulp and corn increased daily gain in relation to lambs fed alfalfa hay and corn. Feeding Bovatec increased profits over feed costs. Feeding 6 mg Smilagenin daily increased lamb gains.

Rotational grazing by lambs showed birdsfoot trefoil and cicer milk vetch are less liked than alfalfa or red clover. Cicer milk vetch caused photosensitization and was difficult to establish. Individual lamb performance and production/ha was not affected by species grazed.

Protein metabolism of lactating ewes show that inadequate dietary protein results in poor nitrogen retention into issues of the ewe. Ewes nursing twin lambs utilized all of their dietary retained nitrogen plus a portion of their tissue reserves early in lactation. Extensive depletion of tissue nitrogen reserves would limit a ewe's potential in accelerated lambing programs.

Carcass evaluation of young ram lambs fed high roughage diets combined with electrical stimuation of the carcasses immediately after slaughter show improved tenderness. These ram lamb carcasses had higher carcass content of total unsaturated fatty acids than cryptorchids or castrates. Meat from young ram lambs more closely approached current human dietary guidelines than meat from castrates.

<u>USEFULLNESS OF FINDINGS</u>

Progress in increasing the efficiency of reproduction and growth in sheep is being made by research on early breeding of ewes; studies with Booroola Merino, Ramanov and Texel crosses; elimination of seasonality of breeding and in the biological control of reproduction. Feeding strategies show that ionophores improved feed conversion, Hampshire sires can improve the gain and yield of St. Croix lambs, pelleting of barley may be beneficial and young forage-fed ram lambs carcasses have a higher content of total unsaturated fatty acids then castrates.

APPROVED:

D. P. Lynch 31, Mar. 1988
Chair, Technical Committee Date

9-8-88
Administative Adviser Date

Publications

California

Journal Articles:

Iniguez, L. C., G. E. Bradford and Okeyo A. Mwai. 1986. Lambing date and lamb production of spring-mated Rambouillet, Dorset and Finnsheep ewes and their F_1 crosses. J. Anim. Sci. 63:715-728.

State Station:

Bradford, G. E. and D. B. Van Liew. 1987. Selection for genetic improvement and eliminating recessive defects. Proc. Sheep Breeding School, Hopland Field Station, June 19-20. pp. 43-48.

Illinois

Journal Articles:

Thomas, D. L., P. J. Thomford, J. G. Crickman, A. R. Cobb and P. J. Dziuk. 1986. Effects of plane of nutrition and phenobarbital during the pre-mating period on reproduction in ewes fed differentially during the summer and mated in the fall. J. Anim. Sci. 64:1144-1152.

Waldron, D. F., D. L. Thomas, J. M. Stookey and R. L. Fernando. 1986. Relationship between growth of Suffolk rams on central performance test and growth of their progeny. In: G. E. Dickerson and R. K. Johnson (Ed.) Proc. Third World Cong. Genet. Appl. Livestock Prod. IX:639-644. University of Nebraska, Institute of Agriculture and Natural Resources, Lincoln.

Indiana

Journal Articles:

Hudgens, R. E., J. L. Albright and J. A. Pennington. 1986. Influence of feeding time and diet on time of parturition in multiparous ewes. J. Anim. Sci. 63:1036-1040.

State Station:

Yoder, R. A., R. E. Hudgens, T. W. Perry and K. D. Johnson. 1987. Growth and reproductive performance of ewe lambs supplemented with corn or soybean meal while grazing pasture. 1987 Indiana Sheep Day Report.

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Iowa

State Station:

Sanderson, M., W. Wedin and D. Morrical. 1987. Sequential Grazing of Steers and Ewes - A Progress Report ISU Beef Cattle Research Report. ASR 451:99.

Morrical, D. 1986. Performance of Lambs and Steers Grazing Embark Treated Pastures. Outlying Research Center Annual Report. ORC86-02:7.

Morrical, D. 1986. Lamb Performance as Affected by Crude Protein Level of Creep Rations. Outlying Research Center Annual Report. ORC86-02:9.

Morrical, D. 1986. Observations on Oat Hay Feeding to Gestating Ewes. Outlying Research Center Annual Report. ORC86-02:10.

Kansas

State Station:

Kansas Sheep Research. 1986. Report of Progress 515. Kansas State University Agricultural Experiment Station.

Schwulst, Frank J. 1986. Lifetime Production Performance by Suffolk x Rambouillet Ewes in Northwestern Kansas. Kansas Agricultural Experiment Station. Keeping Up With Research No. 91.

Kentucky

State Station:

Ely, D. G. and W. P. Deweese. 1987. Performance of finishing lambs supplemented with lipid coated protein. University of Kentucky Prog. Rpt. 304:11.

Kemp, J. D., D. G. Ely and W. P. Deweese. 1987. A comparison of lamb growing finishing diets. Univ. of Kentucky Prog. Rpt. 304:12.

Nicastro, F., W. G. Moody, J. D. Kemp and D. G. Ely. 1987. Histological characteristics of carcasses from lambs fed different sources and levels of dietary protein. University of Kentucky Prog. Rpt. 304:14.

Minnesota

State Station:

Jordan, R. M. and Hanke, H. E. 1986. Effect of adding Bovatec to lamb creep diets. Proc. 58th Sheep Feeders Day. University of Minnesota, Morris (S-226).

Jordan, R. M. and Hanke, H. E. 1986. Effect of yeast in lamb creep diets. Proc. 58th Sheep Feeders Day. University of Minnesota, Morris (S-227).

Jordan, R. M. and Hanke, H. E. 1986. Effect of ground lupin seed in lamb creep diets. Proc. 58th Sheep Feeders Day. University of Minnesota, Morris (S-228).

Jordan, R. M. 1986. Effect of rumen protected methionine and lysine in lamb creep diets. Proc. 58th Sheep Feeders Day. University of Minnesota, Morris (S-229).

Jordan, R. M. 1986. Sheep milk and Roquefort cheese production in southern France. Proc. 58th Sheep Feeders Day. University of Minnesota, Morris (S-230).

Jordan, R. M. 1986. English agriculture. Proc. 58th Sheep Feeders Day. University of Minnesota, Morris (S-231).

Jordan, R. M. 1986. Portents of sheep breeds to come. Proc. 58th Sheep Feeders Day. University of Minnesota, Morris (S-232).

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North Dakota

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Ohio

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<u>Virginia</u>

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<u>Journal Articles</u>:

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<u>U.S. MARC</u>

<u>Journal Articles</u>

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<u>South Dakota</u>

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<u>Texas</u>

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Theses:

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U.S. Beltsville

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U.S. MARC

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Leymaster, K. A. 1987. The crossbred sire: Experimental results for sheep. J. Anim. Sci. (Accepted).

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MINUTES
1988 Annual Meeting
NC-111 Technical Committee

Monday, June 13

The Sheep Industry Development Program (SID) served as host for the Annual meeting. The meetings were held at the Stapleton Plaza Hotel and fitness Center in Denver, Colorado. A social reception was held at the American Sheep Producers Council (ASPC) office at 200 Clayton Street, Denver, beginning at 4:30 p.m. Following the social reception, the opening session convened at the hotel at 7:15 p.m. Chairman of the NC-111, Dr. G. Paul Lynch, called the opening session to order and introduced Paul Rodgers of ASPC. Paul welcomed NC-111 participants to Denver and expressed ASPC's willingness to cooperate with this group. He explained that SID is the educational arm of the ASPC. He went on to say that he hoped ASPC and NC-111 could continue to cooperate on future projects that would benefit the American Sheep Producers.

Dr. Kirklyn Kerr was introduced as the new administrative advisor to NC-111. Dr. Kerr said he was pleased to serve as advisor to this group and he was looking forward to the meetings. Dr. Kerr indicated that he sheared sheep to help finance his way through college. He has a DVM degree from Ohio State University. In regard to grants, Cooperative Grants are expected to be funded at the same level as last year with a 3% Graham-Ruddman decrease.

Dr. Lynch introduced Mike Caskey, Chairman of the SID Board of Trustees. Mike expressed his gratitude to NC-111 participants for their research toward solving problems facing sheep producers. He went on to outline three main issues that need to be researched so answers to these issues could be provided. They are:

1. Ram lamb issue - At present, the difficulty of pulling ram pelts is of concern by slaughter plants. Research should address the influence of sex, age, breed and stress on pelting of lambs.

2. Lean lamb issue - Slaughter plants need objective means of identifying fat and lean on lamb carcasses. This objective measure must be accurate, repeatable, easily and rapidly collected and cost effective. An objective means to evaluate superior breeding stock is needed.

3. Out-of-season breeding - Research should address ways to shift or extend the breeding season of sheep so that lamb supply at the market place will be less seasonal.

Mike Caskey then introduced the SID Board of Trustees: Henry Etcheverry, Idaho (Vice Chairman); John Etchepare, Wyoming (Secretary); Kemper Huber, Wyoming; Bill Schneemann, Texas and Paul Rodgers, coordinator of the Sheep Industry Development Program.

Dr. Lynch introduced Dr. Millard Calhoun, Texas A&M University Agricultural Research and Extension Center, San Angelo. Millard gave an

update on the IR-4 Project Activities. The IR-4 is a national ag project designed to help assist with getting clearance of safe animal drugs, biorationals (microbial and biochemicals) and pesticides for use by minor species such as sheep and goats. IR-4 headquarters is at Rutgers University, New Brunswick, NJ. Before an IR-4 project is funded, you must meet the following: (1) demonstrate a need for a product to control or solve a problem (2) clearance in major species (3) researchable project and
(4) cooperation from pharmaceutical companies. The FDA is strongly in favor of the IR-4 and it appears that this program will be successful. Requirements to get some drugs approved have been eased somewhat and some foreign data is being accepted.

Dr. Lynch presented a program on "The efficiency of young ram lambs". He discussed a 120-day management system for ram lambs. The advantages of ram lambs are: increased ADG, decreased fat and increased lean. The disadvantages of ram carcasses are: color and texture of the carcass fat, tenderness of the carcass and pelt removal. Paul continued to discuss methods he has researched to improve tenderness of ram carcasses. Electrical stimulation and shrouding carcasses will improve tenderness. Discussion from the group continued on the pros and cons of leaving rams intact.

Dr. Lynch introduced Dr. A.L. Slyter, South Dakota State University. Dr. Slyter gave an update on the current knowledge of melatonin as a hormone to extend the breeding season in sheep. He summarized much of the current research from the U.S. and other countries that demonstrate melatonin can extend the breeding season in sheep.

Meeting adjourned at 10:00 p.m.

Following the meeting, Dr. Paul Lynch appointed the following people to:

Nominating Committee

Dr. Dave Heaney
Dr. Frank Schwulst
Dr. Art Pope

Resolutions Committee

Dr. Margaret Benson
Dr. Don Ely
Dr. Dan Morrical

Tuesday, June 14

Morning Session
Dr. Lynch called the morning session to order at 8:00 a.m.
Station reports, Objective 1: Increase the efficiency of reproduction and growth in sheep.

1. Ag Canada - Dr. Dave Heaney reported that the Ag Research Centre, Ottawa was discontinuing their sheep research program. All projects will be completely phased out by April, 1990. Some of the synthetic lines of sheep developed at Ag Canada will be registered as new breeds in Canada and will be offered to the public with strict guidelines for disposal. Dave expressed his appreciation to the NC-111 sheep research group for the many years of friendship and professional association.
2. California (William Cushwa, graduate student working with Dr. Bradford)
3. Idaho (Youngs)
4. Illinois (Dan Waldron, graduate student working with Dr. Thomas)
5. Minnesota (Jordan for Boylan)
6. North Dakota (Ringwall)
7. Oregon (Meyer)
8. Texas (Shelton)
9. Virgin Islands (Wildens)

Break for lunch 12:20 p.m.

Afternoon Session (reconvene 1:20 p.m.)

10. Utah-Dr. Warren Foote presented an update on the scrapie program. Dr. Foote attended a meeting in May in Washington with producers, researchers and USDA people to discuss the current indemnity program. As it is,the scrapie program is not very successful and ways were discussed to improve or change this program. This group decided on a Certified Scrapie Free Flock program where sheep producers could get their flock certified as scrapie free. Details of the program are not in place at present and the indemnity program is still in effect.
11. Virginia (Notter)
12. USDA Dubois (Ercanbrack)
13. USDA Jornada (Hulet)
14. USDA MARC (Young and Leymaster)
15. Kansas (Schwulst)

Station reports, Objective 2: Develop feeding strategies for high producing sheep.

16. Indiana (Hudgens)
17. Iowa (Morrical) Dr. Morrical reported on the National Sheep Improvement Program (NSIP). At present there are 28,000 ewes from 480 flocks enrolled in NSIP.

Break: 5:30 p.m. Paul Rodgers announced that SID was sponsoring a reception before the evening meal from 5:30 to 6:30 p.m.

6:30 p.m. NC-111 Dinner
7:45 p.m. Reconvene to continue station reports.

18. Kentucky (Ely)
19. Minnesota (Jordan)

20. North Dakota (Erickson)
21. Ohio (McClure)

Station reports completed-9:15 p.m.

Phil Loggins, University of Florida, announced to the group that he was retiring. He expressed his thanks to those present as well as past associates for their friendship and cooperation through his tenure with NC-111.

Dr. Paul Lynch called the annual NC-111 Business Meeting to order at 9:20 p.m.

Dr. Dave Heaney, secretary for NC-111 in 1987, reported the highlights of the 1987 minutes and items requiring action at this meeting. Two main items that need to be addressed are; (1) details of the meeting in 1989 at Oregon State University and (2) a method for getting the 1988 NC-111 proceedings report printed.

Dr. Steve Zobrisky, CSRS representative, was unable to attend because of another commitment. He sent the following comments through Ken McClure. Members of NC-111 should be aware of Designing Foods, Western Regional Sheep Project report and The Animal Care committee report.

Dr. Paul Lynch reported that researchers at North Carolina State University were requesting permission to submit a proposal for participation in the NC-111 project. Dr. Margaret Benson, Michigan State University, has sent a proposal for participation in the NC-111 project to Dr. Lynch. Paul will circulate Margaret's proposal to all participating research stations. Dr. Larry Young reviewed the procedure for submitting and accepting new proposals. He said the new proposal should be sent to all official participants (project leader) of the NC-111 Sheep Research Committee. After all members have reviewed the new proposal, then each project leader should vote to accept or reject the new proposal. The proposal critique and vote does not have to take place at an annual meeting. It could be handled through the mail.

Discussion on the 1989 NC-111 meeting: It was moved by Dr. Slyter that the 1989 NC-111 Annual Meeting be held at Oregon State University in conjunction with the WRCC-39 sheep research group. Motion was seconded and passed. Dr. Frank Schwulst suggested that the NC-111 officers design a program. Dr. Lowell Slyter recommended a mini-symposium as part of the overall program on some topic that would be of interest to researchers from NC-111 and WRCC-39. Dr. Howard Meyer suggested a symposium on wool. Howard also recommended that we begin our meeting on a Wednesday evening, have station reports on Thursday and finish with all business by Friday noon. Leave Corvallis about noon on Friday for tours of sheep operations. On Saturday, a fishing trip could be planned with a Salmon bake on Saturday evening. By starting on Wednesday and staying over the weekend, cost of air travel should be less. Howard indicated that Limo service was available from Eugene and Portland airports to Corvallis. Discussion followed on possible dates for the meeting. It was moved and seconded that the date for the 1989

meeting be June 14-16. Motion carried. A possible site for the 1990 meeting was discussed. Dr. Dave Notter has extended an invitation if approval is granted by administrators at VPI. Dr. Maurice Shelton also indicated that the NC-111 meeting could be held at San Angelo. Dr. Bob Jordan also suggested MARC as a possible site for the NC-111 meeting.

Dr. Kris Ringwall advised the group that not enough slides were provided to put together a slide set on research accomplishments by NC-111. Kris offered to return those slides that were sent to him.

Printing of the NC-111 proceedings were discussed. Dr. Larry Young reported that the cost for printing a recent Swine report was 7.4¢ per page. Paul Rodgers has indicated that ASPC would publish our proceeding at their cost. Dr. Lynch said he would look into the least expensive means of getting the 1988 proceedings published. It was moved by Dave Notter that the cost of printing the proceedings of future NC-111 meetings be included as part of the registration fee. The motion was seconded by Dave Heaney. Discussion; the advantage of including the printing of proceedings in the registration fee is that all those in attendance of the meeting will get a copy of the proceeding i.e. graduate students and others. The motion passed.

A report by the Nominating Committee (Heaney, Chr., Pope, Schwulst) was presented. Dr. Heaney indicated that we must depart from the traditional progression and elect a new slate of officers. The following slate of candidates were nominated:

Chairman--------Larry Young
Vice Chairman---Howard Meyer
Secretary-------Woody Lane

A motion was made and seconded to elect the slate of candidates as presented by the Nominating Committee. The motion carried unanimously.

The report of the Resolutions Committee (Ely, Chr., Benson, Morrical) was presented. It was moved and seconded that the proposed resolutions be accepted with a few additions. The motion carried. The approved resolutions are attached to these minutes.

Dr. Art Pope commented that this would be his final NC-111 meeting. Art said that this Research Committee originally began as NC-50 in the early 1950's. Three states participated in the first meeting which he chaired (North Dakota, Illinois and Ohio). These early meetings were a model of cooperation because they shared and exchanged data, sheep, diets and etc. Dr. Pope said we have a challenge because this group has become so large, not everyone can report and still have time to discuss research. We need to examine ways to make the meeting more efficient and productive. He also said that we must not forget the sheep producer and their needs when deciding on research projects. We need to continue to look at the economics of sheep production and design research projects that can benefit the sheep producer. Dr. Pope wished the group lots of luck in the future and he expressed his appreciation for the fellowship and professional alliance he has had with this group through the years.

New Business was called for, hearing none, the meeting was adjourned, 10:10 p.m.

Wednesday, June 15

A symposium on "Methods to improve the lean yield of lambs" was presented by NC-111 and SID. Proceedings of this symposium will be made available by SID.

Thursday, June 16

A tour group departed from Stapleton Plaza Hotel, 7:00 a.m. for Warren Livestock Company, Cheyenne, Wyoming; lamb feedlots, Greeley, Colorado and CSU research facilities, Ft. Collins.

APPROVED RESOLUTIONS
1988 MEETING OF THE NC-111 TECHNICAL COMMITTEE

1. The members of the NC-111 Technical Committee wish to express their thanks to the Sheep Industry Development for their efforts in hosting the 1988 NC-111 annual meeting and for continued publication of an ever-improving SID research journal.

2. The members of the NC-111 Technical committee wish to express their appreciation to Steve DeVelly for organizing the tour.

3. The members of the NC-111 Technical Committee wish to express our appreciation to ASPC for providing hors d'oeuvres at the reception.

4. The members of the NC-111 Technical Committee wish to express our appreciation to Larry Meade of Sheep Breeder and Sheepman Magazine for providing the liquid refreshments at the reception.

5. The members of the NC-111 Technical Committee wish to congratulate Steve Zobrisky, Dave Heaney and Phil Loggins on their retirement, and express our appreciation for their tireless efforts toward improving the sheep industry.

6. The members of the NC-111 Technical Committee wish to thank Paul Rodgers for his efforts in regard to SID, NSIP and coordination of the NC-111 annual meeting and Lean Lamb Symposium.

7. The members of the NC-111 Technical Committee wish to express their appreciation to the National Wool Grower's Association for continuation of their scholarship program.

PURDUE UNIVERSITY

DEPARTMENT
OF ANIMAL SCIENCES

July 20, 1988

Mr. Paul Rodgers
Box 841
Christiansburg, VA 24073

Dear Paul,

The NC-111 Regional Technical Committee on research for "Increased Efficiency of Sheep Production" adopted the following resolution at the 1988 annual meeting:

"The members of the NC-111 Technical Committee wish to thank Paul Rodgers for his efforts in regard to SID, NSIP and coordination of the NC-111 annual meeting and Lean Lamb Symposium".

This committee, as well as producers in the industry, are grateful for your efforts and appreciate your leadership.

Sincerely,

Robert

Robert E. Hudgens
Secretary
NC-111 Technical Committee

REH/bp

cc: Rodger Wasson

LILLY HALL • WEST LAFAYETTE, IN 47907 • (317) 494-4808

PURDUE UNIVERSITY

DEPARTMENT
OF ANIMAL SCIENCES

July 20, 1988

Rodger Wasson, Executive Director
American Sheep Producers Council
200 Clayton Street
Denver, CO 80206

Dear Rodger:

The NC-111 Regional Technical Committee on research for "Increased Efficiency of Sheep Production" adopted the following resolutions at the 1988 annual meeting:

"The members of the NC-111 Technical Committee wish to express their thanks to the Sheep Industry Development for their efforts in hosting the 1988 NC-111 annual meeting and for continued publication of an ever-improving SID research journal."

"The members of the NC-111 Technical Committee wish to express our appreciation to ASPC for providing hors d'oeuvres at the reception".

This group is sincerely thankful for the relationship that exists between NC-111 and ASPC. We would like to continue to improve our relations so that we can both better serve the sheep industry in the future.

Sincerely,

Robert

Robert E. Hudgens
Secretary
NC-111 Technical Committee

REH/bp

LILLY HALL • WEST LAFAYETTE, IN 47907 • (317) 494-4808

PURDUE UNIVERSITY

DEPARTMENT
OF ANIMAL SCIENCES

July 20, 1988

Mr. Larry Mead, Editor
Sheep Breeder and Sheepman Magazine
P.O. Box 796
Columbia, MO 65202

Dear Larry:

The NC-111 Regional Technical committee on research for "Increased Efficiency of Sheep Production" adopted the following resolution at the 1988 annual meeting:

"The members of the NC-111 Technical Committee wish to express our appreciation to Larry Mead of Sheep Breeder and Sheepman Magazine for providing the liquid refreshments at the reception".

Your continued support is appreciated and the refreshments were particularly welcome for our social hour.

Sincerely,

Robert

Robert E. Hudgens
Secretary
NC-111 Techincal Committee

REH/bp

LILLY HALL • WEST LAFAYETTE, IN 47907 • (317) 494-4808

PURDUE UNIVERSITY

DEPARTMENT
OF ANIMAL SCIENCES

July 20, 1988

Dr. David P. Heaney
Animal Research Centre
Agriculture Canada
Ottawa, Ontario
Canada, K1A 0C6

Dear Dave:

The NC-111 Technical Committee on research for "Increased Efficiency of Sheep Production" adopted the following resolution at the 1988 annual meeting:

"The members of the NC-111 Technical Committee wish to congratulate Steve Zobrisky, Dave Heaney and Phil Loggins on their retirement and express our appreciation for their tireless efforts toward improving the sheep industry".

We are grateful for your hours of dedicated service. Your contributions to the sheep industry have not gone unnoticed and we will continue to benefit by your work. While we recognize that you will not be directly involved with this committee, we invite you to check in on us from time to time as we value your knowledge and support. Good Luck.

Sincerely,

Robert

Robert E. Hudgens
Secretary
NC-111 Technical Committee

REH/bp

LILLY HALL • WEST LAFAYETTE, IN 47907 • (317) 494-4808

PURDUE UNIVERSITY

DEPARTMENT
OF ANIMAL SCIENCES

July 20, 1988

Phillip Loggins
University of Florida
1625 N.W. 14 Avenue
Gainesville, FL 32605

Dear Phil:

The NC-111 Technical Committee on research for "Increased Efficiency of Sheep Production" adopted the following resolution at the 1988 annual meeting:

"The members of the NC-111 Technical Committee wish to congratulate Steve Zobrisky, Dave Heaney and Phil Loggins on their retirement and express our appreciation for their tireless efforts toward improving the sheep industry".

We are grateful for your hours of dedicated service. Your contributions to the sheep industry have not gone unnoticed and we will continue to benefit by your work. While we recognize that you will not be directly involved with this committee, we invite you to check in on us from time to time as we value your knowledge and support. Good Luck.

Sincerely,

Robert

Robert E. Hudgens
Secretary
NC-111 Technical Committee

REH/bp

LILLY HALL • WEST LAFAYETTE, IN 47907 • (317) 494-4808

PURDUE UNIVERSITY

DEPARTMENT
OF ANIMAL SCIENCES

July 20, 1988

Dr. Steve Zobrisky
USDA/CSRS
Room 219-A
J.S. Morrill Bldg.
Washington, D.C. 20251

Dear Steve:

The NC-111 Technical Committee on research for "Increased Efficiency of Sheep Production" adopted the following resolution at the 1988 annual meeting:

"The members of the NC-111 Technical Committee wish to congratulate Steve Zobrisky, Dave Heaney and Phil Loggins on their retirement and express our appreciation for their tireless efforts toward improving the sheep industry".

We are grateful for your hours of dedicated service. Your contributions to the sheep industry have not gone unnoticed and we will continue to benefit by your work. While we recognize that you will not be directly involved with this committee, we invite you to check in on us from time to time as we value your knowledge and support. Good Luck.

Sincerely,

Robert

Robert E. Hudgens
Secretary
NC-111 Technical Committee

REH/bp

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PURDUE UNIVERSITY

DEPARTMENT
OF ANIMAL SCIENCES

July 20, 1988

Steve LeValley
Department of Animal Science
Colorado State University
Fort Collins, CO 80523

Dear Steve:

The NC-111 Regional Technical Committee on research for "Increased Efficiency of Sheep Production" adopted the following resolution at the 1988 annual meeting:

"The members of the NC-111 Technical Committee wish to express their appreciation to Steve LeValley for organizing the tour".

I heard many good comments about the tour. We appreciate your efforts. We think it is important for researchers to stay in touch with sheep producers' needs. This tour helps us recognize producers' needs and stimulates ideas for future research.

Sincerely,

Robert

Robert E. Hudgens
Secretary
NC-111 Technical Committee

REH/bp

LILLY HALL • WEST LAFAYETTE, IN 47907 • (317) 494-4808

PURDUE UNIVERSITY

DEPARTMENT
OF ANIMAL SCIENCES

July 20, 1988

Dr. Jim Butler
National Wool Growers Association
#10 Lakeside Ln., Suite 200
Denver, CO 80212

Dear Jim:

The NC-111 Regional Technical Committee on Research for "Increased Efficiency of Sheep Production" adopted the following resolution at the 1988 annual meeting"

"The members of the NC-111 Technical Committee wish to express their appreciation to the National Wool Grower's Association for continuation of their scholarship program".

This group values the support of NWG and recognizes the need to assist graduate students that are interested in working with sheep.

Sincerely,

Robert

Robert E. Hudgens
Secretary
NC-111 Technical Committee

REH/bp

LILLY HALL • WEST LAFAYETTE, IN 47907 • (317) 494-4808

ADDENDUM TO REGIONAL RESEARCH PROJECT OUTLINE

Addendum to NC-111 regional project covering research at Michigan State University.

TITLE: Increasing Prolificacy in Sheep and It's Impact on Nutritional Needs.

OBJECTIVE: NC-111 Project Objective II:
Develop feeding strategies for high-producing sheep.

PROCEDURES: The application of forage based agriculture to sheep production will be studied in this project. Specifically, this will include the identification of feeding systems which extensively utilize pasture and high forage diets for various classes of sheep (to include: maintaining, gestating or lactating ewes and/or growing finishing lambs).

A grazing study presently in progress, will be continued for at least 2 additional years and is designed to compare the plant and animal interaction as influenced by grazing systems. The systems being evaluated includes comparisons among: continuous grazing at a low stocking rate (10 lambs/acre), continuous grazing at a high stocking rate (20 lambs/acre), and an 8 paddock rotational grazing system at a high stocking rate (20 lambs/acre). One hundred sixty crossbred lambs (30 kg) are utilized to graze .5 acre pastures to measure rate of gain and animal product produced per acre. Quality (CP, NDF, ADF, ADL, IVDMD, botanical composition) and quantity (DM yield/acre) of the mixed grass legume forage is being monitored throughout the grazing season. Product (animal and plant) yield and economic viability of these systems will also be assessed and compared to that of mechanical harvest systems.

In the next 2 years of this grazing study, additional components will be added to include: estimates of forage intake on pasture using markers and/or cannulated animals; in vivo evaluation of DM, fiber and N digestibilities using green chop forage fed in metabolism studies; and study the use of metabolic indicators to evaluate nutritional status of the animals.

Continued
Page 2

PROCEDURES-Cont: Other studies to be included in this project are: 1) Definition of nutrient requirements (protein and energy) for high producing sheep at various stages of production; 2) Evaluation of reed canarygrass varieties (with low and intermediate levels of alkaloids) as a pasture grass for ruminant livestock on lowland muck soil types; and 3) The response of digestibility and fiber utilization on high roughage diets supplemented with concentrate feeds.

PROJECT LEADER: Margaret E. Benson
Ruminant Nutrition

RESOURCES: SY = .2

SIGNATURES:

Robert F Gast ______________________ 9/20/88 ______
Director, Petitioning Station, Agency, or Institution — Date

______________________ ______
Administrative Advisor — Date

______________________ ______
Administrator, Cooperative State Research Service — Date

NC-111. Increasing Prolificacy in Sheep and its Impact on Nutritional Needs

University of California, Davis
Contributing Project Report, June 1988

Personnel: G. E. Bradford, D. B. Van Liew, M. R. Dally, W. T. Cushwa, Y. M. Berger and G. H. Stabenfeldt

Objective: Increase prolificacy and embryonic survival and reduce seasonality in sheep.

A. Increasing prolificacy and embryonic survival.

A line of grade Targhees has been selected for multiple births since 1963, and has consistently higher prolificacy than an unselected control. Two lines selected for increased weaning weight are a part of the same experiment. No new data summaries have been done during 1987-88, but selection has been continued. In July and August 1988 we will measure ovulation rate on 350 ewes from this project, including pure line ewes of the 4 groups, and linecross ewes from 3 x 3 and 2 x 2 diallel crosses, both sets involving the multiple birth (T) line. This will provide data on line differences and on heterosis in ovulation rate and embryo survival.

Embryos from the four lines have been collected and frozen each of the past two breeding seasons (autumn 1986 and 1987), as part of the University of California Genetic Resources Conservation Program.

B. Reducing Seasonality.

The principal project in 1987-88 has been a study of the effect of: (1) degree of isolation of ewes from rams, (2) date of ram introduction and (3) location, on induction of estrus and conception in anestrous ewes by the "ram effect". A total of 280 ewes in each of two years (spring 1987, spring 1988) is involved. Ewes were either separated by at least 1 mile from rams or kept in close proximity to rams, beginning March 15 and continuing until breeding rams were introduced, either May 15 or June 15. The two locations are Davis and Hopland Field Station. In 1987, two laparoscopies were performed, 4-5 days and 11-12 days after ram introduction, to check for short cycles. Blood samples taken on the date of ram introduction were assayed for progesterone, to identify ewes already cycling.

In 1987, more than 95% of ewes were anestrous on May 15, as indicated by progesterone levels <.5 ng/ml. About 19% of ewes cycling by June 15. Response to ram introduction was good in all groups, with 81% of all anestrous ewes were exposed conceiving within 29 days of ram introduction, as indicated by lambing dates. Results are summarized in table. 1.

Table 1. Response to ram effect, 1987

	May				June			
	Isolated		Adjacent		Isolated		Adjacent	
No. ewes	Davis	Hopland	Davis	Hopland	Davis	Hopland	Davis	Hopland
Assigned	35	35	35	35	34	37	36	34
Present at lambing	33	34	34	30	29	34	36	31
Initial prog. ≥ .5 ng	2	0	0	0	1	4	14[a]	0
Lambed ≤ 154 d.	1	0	2	0	0	0	4[a]	0
"Eligible" to respond	30	34	32	30	28	29	18	31
(% anestrus)	91	100	94	100	97	85	50	100
Lambed 155-179d	25	23	27	17	26	23	16	30
% response	83	68	84	57	93	79	89	97

Totals:						
	Davis	87.0%	May	73.0%	Isolated	80.2%
	Hopland	75.0	June	89.6	Adjacent	81.1

a) Davis adjacent group apparently induced to ovulate prior to ram introduction in June.

Laparoscopy results did not appear to provide an accurate indication of the occurrence of short cycles. A significant percentage of ewes diagnosed as having short cycles, based on difference between the two examinations in number or location of corpora lutea, lambed between 162 and 169 days after ram introduction, suggesting induction of a normal cycle, rather than a short followed by a normal cycle.

To provide additional information on this point, twice weekly blood samples for the two weeks following ram introduction have been taken in 1988, and will be assayed for progesterone. In addition, estrus is being monitored for one month after ram introduction in 1988.

The ram effect study is being done at Davis primarily with Rambouillet x Finn-Dorset (RFD) crossbred ewes, which will form the foundation stock for selection for spring/early summer breeding performance. Selection will be initiated based on 1988 performance. The available RFD ewes have been allocated at random to selected (A) and control (C) lines, with the same rams used across both groups in 1988. An additional group of ewes, also predominantly crosses involving the R, F and D breeds but not carrying precisely .5, .25, .25 of the three breeds respectively, and including a few pure R ewes and a few with one-eighth or one-fourth Barbados breeding, are being carried as a second selected line. A portion of these ewes are being mated to two rams from a private breeder in California who has been selecting for early lambing for 25 years. This second line (B) will be carried as an open line, with addition of ewes with a superior record of early breeding, from other projects or private breeders, as the opportunity occurs. Line C will serve as a control for both A and B selected lines.

In April 1988, 100 RFD ewes and 12 RFD rams were divided at random into two groups each, one of which was sent to the VPI Station at Steele's Tavern, Virginia, with the other retained here. These were exchanged for 50 DRF ewes and 6 DRF rams similarly sampled from the VPI flock which is being used to produce the base population for the VPI selection experiment. The 50 each RFD and DFR ewes at each location will be bred to rams of their own line for two seasons (1988 and 1989) with all daughters kept and mated for a minimum of two seasons. Estimates of strain, location and location carryover effects on lambing date, prolificacy and other production parameters will be made. In addition to quantifying strain and location effects and their interaction with regard to seasonal breeding, the project will provide a comparison, within each location, of the base populations for the two selection lines, as a reference point for comparing the selection responses.

Work planned for 1988-89

In addition to the measurement of ovulation rate and embryo survival described under (A) above, we will complete and report results of the two-year study on ram effect (W. T. Cushwa M.S. thesis), collect data on the UC/VPI GxE interaction study, and initiate selection for early lambing.

Publications:

Quirke, J. F., G. H. Stabenfeldt and G. E. Bradford. 1988. Year and season effects on oestrus and ovarian activity in ewes of different breeds and crosses. Animal Reproduction Science 16:39-52.

NC-111 Regional Research Project
"Increasing Prolificacy in Sheep and its Impact on Nutritional Needs"
1988 Annual Report
University of Idaho

Personnel: C.R. Youngs, S.L. Waller, S.C. Duplantis, Jr., L.K. McGinnis

Objective 1: Increase prolificacy and embryonic survival and reduce seasonality in sheep

A. Selection to increase ovulation rate in Suffolk ewes

A selection study has been initiated to examine the direct and correlated responses to selection for increased ovulation rate in Suffolk ewes. Four sire lines will be maintained with a projected total of 120 ewes. A 2:1 ratio of selected ewes to control ewes will be utilized. Ewes will be mated beginning in early October of each year during a 35-day breeding season. Ovulation rate will be assessed via laparoscopy, and litter size observations will permit the calculation of embryonic loss (assuming all ova ovulated are fertilized). Data from the fall 1987 breeding season (spring 1988 lambing season) are presented in table 1 below. Ovulation rates presented correspond to the ovulation rate at the estrous cycle of conception, while litter size observations are lambs born (dead or alive) or aborted. An abortion problem caused by Campylobacter jejuni occurred in the ewe lambs.

TABLE 1. Mean ovulation rate and litter size of Suffolk ewes.

Age at lambing	n	Ovulation Rate	Litter Size
7	6	2.17	1.83
6	4	1.75	1.75
5	6	2.17	2.17
4	12	2.42	1.92
3	14	2.21	1.93
2	16	1.88	1.81
1	29	1.31	1.03

Scrotal circumference measurements will be taken from ram lambs at 60 and 120 days, while age at puberty will be assessed in the ewe lambs. Ewes culled (for age) from the control flock will be superovulated in an effort to collect embryos for cryopreservation. This would enable a comparison of the foundation control line with the control population at some subsequent point in later generations.

B. Use of Pregnancy Specific Protein B to Determine Pregnancy and Early Embryonic Loss in Sheep (G. Sasser, cooperator)

A study was conducted to evaluate the use of pregnancy specific protein B (PSPB) for the detection of pregnancy and early embryonic loss in sheep. Daily blood samples were taken between days 14 and 28 (inclusive) after mating and at 20 day intervals thereafter beginning at day 40. Levels of PSPB will be determined by RIA, and this data will be correlated with observed estrus dates, ovulation rates, and litter size information. Data in ewe lambs will be examined to see if PSPB levels differ between single and twin pregnancies, while data from Panama ewes will be utilized to assess breed differences in PSPB levels.

C. Determination of the Date of Onset of First Estrus in Suffolk and Panama Sheep

A study was conducted to determine the date of onset of the breeding season in mature Suffolk (n=52) and Panama (n=39) ewes. Historically, these ewes had been placed into breeding on or about August 10 each year. This was changed in the fall of 1986 when breeding was delayed until approximately October 10. Twice weekly blood samples were taken from June 23 until September 15, 1987 (inclusive) for subsequent progesterone analysis. Vasectomized rams (n=3) fitted with marking harnesses were placed with the ewes on July 10, 1987 to monitor estrus activity. Ewes were examined daily for raddle marks, and crayons were changed every 14 days. Six to eleven days after observed estrus, ewes were subjected to laparoscopy to verify that ovulation had accompanied estrus. Ewes exhibiting two consecutive estruses accompanied by ovulation were removed from the study at that point to minimize the number of blood samples taken as well as the number of ewes which the teasers were expected to monitor. Date of first observed estrus in Panama ewes was August 3 (+ 9 days, while Suffolk ewes exhibited first estrus approximately 5 days later (August 8 + 12 days). This data should enable more detailed studies of the endocrinological changes occurring during the transition from anestrous to the breeding season.

D. An Evaluation of Main-Span Ear Tags for Reproductive Physiology Studies

A study was conducted utilizing a New Zealand designed ear tag which stands up from the ear rather than hanging down. Such a stand up ear tag would be invaluable for studies involving daily heat checking in an area inaccessible to a sheep handling facility. Newborn lambs were tagged in one ear with a Main-Span tag and in the other ear with a Duflex tag. Observations were made by farm personnel involving the ease of insertion, incidence of infection, and longevity of the tags. Preliminary data clearly indicate that the Main-Span tags are not suitable for use in newborn lambs. The tags are difficult to position so that they don't cause the ear to droop or cause an irritation to the eye. Infections were common, as was loss of the tag from the ear. Further investigations are needed to ascertain the potential of this ear tag in mature sheep.

Objective 2: Develop feeding strategies for sheep with high productive rates

A. The Effect of Variety of Rapeseed Forage on Growth Performance of Lambs (C. Hunt, cooperator)

A study was conducted to evaluate three varieties of rapeseed which differed in the level of glucosinolate for palatability and growth in lambs. Cascade, Dwarf Essex, and Jupiter varieties (low, moderate, and high glucosinolate, respectively) were harvested daily and hand fed to lambs. Forty-eight Suffolk lambs (24 of each sex) were randomly allotted to the rapeseed varieties to provide 4 pens per variety (2 of each sex). Lambs were fed a 100% rape forage diet for the 4-week trial. Lambs fed Jupiter had a lower daily dry matter intake, poorer average daily gain, and a higher feed:gain ratio than lambs fed the Dwarf Essex. Data are presented in table 2.

TABLE 2. Growth performance of lambs fed forage from rapeseed varieties differing in glucosinolate content.

	Glucosinolate Content		
Trait	Low	Medium	High
Daily dry matter intake, kg/day	1.05[ab]	1.09[a]	1.00[b]
Average daily gain, kg/day	.13[b]	.19[c]	.09[a]
Feed:Gain	7.66[a]	5.90[a]	12.02[b]

[a,b]Means in the same row with different superscripts differ significantly ($P<.05$)

B. Use of a Maternal Robot for the Artificial Rearing of Orphan Lambs

One of the problems associated with highly prolific sheep is the inability of some dams to adequately rear their young. Recently, a mechanical artificial rearing unit was made available to U.S. sheep producers (Maternal Robot: Biotic Industries, TN). The manufacturer's claim is that this unit will support up to 60 orphan lambs. The machine will automatically mix lamb milk replacer provided that the dry powder is maintained in the reservoir. The unit will mix the initial batch of milk and will automatically mix more milk when needed. It will stir the milk for 3 seconds every 10 minutes. The unit was evaluated on a limited number of orphan lambs in the spring of 1988. The manufacturer is working with us to modify the design and operation of the unit in an effort to make the unit more attractive to sheep producers.

C. **The Efficacy of Totalon for Anthelmintic Control in Sheep**
(W. Foreyt, cooperator)

A study was conducted to evaluate the efficacy of a new levamisole-based pour-on anthelmintic (Totalon: Pitman-Moore, Inc.). Forty mature Panama ewes (average weight of 91 kg) were divided into four groups of ten ewes each. Group 1 ewes served as untreated controls, group 2 ewes served as ivermectin-treated "controls" (2 ml/head), group 3 ewes were treated with 1.5 ml Totalon/head, and group 4 ewes received 3.0 ml Totalon/head. Fecal samples were taken from each ewe on days 0, 10, and 28. Treatments were administered on March 11, 1988 approximately 4 weeks prior to the beginning of lambing (periparturient egg rise should begin) and approximately 6 weeks after shearing (minimal amount of wool). Data analysis revealed no differences among treatment groups for the number of Nematodirus when adjusted for initial egg count. However, Ivomec was significantly better ($P<.01$) than Totalon for reducing the number of Stronglyes at both 10 and 28 days after treatment. Totalon did, however, show a significant ($P<.05$) reduction as compared with untreated controls. Further studies are planned to evaluate this product in lambs as well as mature Suffolk ewes.

Publications:

State Station

Lancaster, L.L.; C.W. Hunt; D.L. Auld; L.M. Kelly; C.R. Youngs. 1987. The effect of variety of rapeseed forage on chemical composition and performance of lambs. University of Idaho Animal Science Department Annual Report, MS108:44-47.

University of Illinois

1988 Station Report to NC-111

"Increasing Prolificacy in Sheep and Its Impact on Nutritional Needs"

I. Objective 1: Increase prolificacy and embryonic survival and reduce seasonality in sheep.

A. **Performance of Rambouillet and F_1 Booroola-Rambouillet Ewes Lambing First at Two Years of Age.** D. L. Thomas, T. G. Nash, D. F. Waldron, R. M. Bunge, and C. P. Matos.

These are preliminary results from a cooperative effort with the U.S.M.A.R.C., Clay Center and several Land Grant University Experiment Stations to evaluate the Booroola Merino. The Illinois station is also cooperating with Israeli scientists at the Volcani Centre, Bet Dagan, Israel (headed by Dr. Elisha Gootwine) on evaluation of the "F" gene in both U.S. and Israeli sheep populations.

In the fall of 1985, the 300 ewes in the Rambouillet flock at the Dixon Springs Agriculture Center were divided into 5 lines: 3 selection lines (litter size, ovulation rate, scrotal circumference), a randomly selected and mated control line and a Booroola Merino backcross line in which the "F" gene will be backcrossed into the Rambouillet. In 1985, 1986 and 1987 ewes in the 3 selection lines and the control line were mated to appropriately selected Rambouillet rams (6 rams per line per year) and ewes in the Booroola backcross line were mated to Booroola Merino rams (3 different rams each year). Since ewes first lamb at 2 yr of age, only the reproduction of the first group of ewes born in 1986 is available. Results are presented in Table 2 for all Rambouillet ewes combined since selection has not yet differentiated the lines.

Table 1. Performance of Rambouillet and Booroola x Rambouillet Ewes Lambing at 2 yr of Age

Breed	No. mated	Ovulation rate	Breeding wt.(kg)	Breeding C.S.	Fleece wt.(kg)	No. lambing	Prolificacy
Rambouillet	50	1.62	55.8	3.8	3.0	44	1.39
Booroola x Rambouillet	21	2.86	49.2	4.0	3.4	19	1.79

Table 2. Number of Rambouillet and Booroola x Rambouillet Ewes With Various Numbers of Ovulations and Lambs Born When Lambing at 2 Yr of Age

Breed/sire	Number of ovulations or lambs born 1	2	3	4	Mean performance
Ovulation rate					
Rambouillet	22	25	3	0	1.62
Booroola x Rambouillet	0	6	12	3	2.86
Sire 315001	0	1	4	1	3.00
Sire 315010	0	2	4	1	2.86
Sire 315012	0	3	4	1	2.75
Number of lambs born					
Rambouillet	27	17	0	0	1.39
Booroola x Rambouillet	6	11	2	0	1.79
Sire 315001	1	3	2	0	2.17
Sire 315010	1	5	0	0	1.83
Sire 315012	4	3	0	0	1.43

The Booroola x Rambouillet ewes were lighter at mating (-6.6 kg) but sheared heavier fleeces (+.4 kg), ovulated more eggs (+1.24) and gave birth to more lambs (+.4) than Rambouillet ewes (Table 1). The distribution of ovulation rates of the daughters of the 3 Booroola rams (Table 2) suggests that all three rams were homozygous for the "F" gene since all daughters had 2 or more ovulations. The lambing data is less discriminating since the daughters of 315012 had a lambing rate very similar to that of the Rambouillets (1.43 vs 1.39). A majority of Booroola x Rambouillet ewers ovulated 3 or more eggs (71%) and gave birth to 2 or more lambs (68%) whereas a majority of Rambouillet ewes ovulated 1 or 2 eggs (94%) and gave birth to 1 lamb (61%).

If 3 or more ovulations is used as the criterion for the presence of the "F" gene in this population, 6% of the Rambouillet ewes would be incorrectly classified as carriers and 29% of the Booroola x Rambouillet ewes would be incorrectly classified as non-carriers. The criteria of 2 lambs or more for the presence of the "F" gene is less discriminatory since 39% of the Rambouillet ewes would be incorrectly classified as carriers and 32% of Booroola x Rambouillet ewes would be incorrectly classified as non-carriers.

B. Illinois Prolific Sheep Breed Study: Reproductive Performance of 1- and 2-year-old Ewes.
D. L. Thomas, T. G. Nash, R. M. Bunge, C. P. Matos and D. F. Waldron.

Six rams of each of the Booroola Merino, Finnsheep, St. Croix, Barbados and Combo-6 breeds were mated to a flock of approximately 120 Targhee and 95 Suffolk ewes in August-September of 1985 and 1986. This study contributes to the Booroola Merino-Finnsheep evaluation involving U.S.M.A.R.C., North Dakota, Kansas, U.S.D.A.-El Reno, Illinois and Texas. Overall fertility of the Suffolk and Targhee ewes has been very low with only 66.3% of the ewes lambing. This has resulted in fewer F_1 ewes than desired being produced. Similar matings were repeated in 1987 and will be again in 1988.

Table 3. Reproduction of One- and Two-Year-Old F_1 Ewes

	No. exposed		Fertility, %		Prolificacy		Lambs/exposure	
Age (yr)	1	2	1	2	1	2	1	2
Breed of dam								
Suffolk	71	26	77.5	76.9	1.55	1.65	1.20	1.27
Targhee	99	31	78.8	77.4	1.31	1.54	1.03	1.19
Breed of sire								
Barbados	33	9	87.9	88.9	1.34	1.50	1.18	1.33
St. Croix	49	19	93.9	78.9	1.37	1.67	1.29	1.32
Booroola	32	13	62.5	61.5	1.60	1.62	1.00	1.00
Combo-6	36	11	69.4	72.7	1.32	1.38	.92	1.00
Finnsheep	20	5	65.0	100.0	1.54	1.80	1.00	1.80

Performance of 1-year-old ewes born in 1986 or 1987 and the 2-year-old ewes born in 1986 are presented in Table 3. At both 1 and 2 years of age, ewes from Suffolk dams produced slightly more lambs per exposure than ewes from Targhee dams due primarily to their greater prolificacy. Breed of sire effects are not consistent across age of ewe. At one year of age, lambs per exposure favors the ewes sired by the two hair breeds (Barbados and St. Croix) due to their very high fertility relative to the wool breeds. At two years of age, Finnsheep-sired ewes are the most productive due to high fertility and prolificacy. The Booroola Merino-sired ewes are disappointing in lambs per exposure with the lowest fertility at both ages and low relative prolificacy at two years of age.

C. **Illinois Prolific Sheep Breed Study: Postweaning Growth and Carcass Merit of F_1 Ram Lambs.** D. L. Thomas, T. G. Nash, F. K. McKeith, R. M. Bunge and D. F. Waldron.

Postweaning growth and carcass data were collected on 100 F_1 ram lambs produced from Finnsheep (FN), Combo-6 (C6), Booroola Merino (BM), St. Croix (SC) and Barbados (BA) sires and Suffolk and Targhee dams. Three sires of each sire breed were used. Lambs were weaned at 56 d. Within each sire breed (SB)-dam breed (DB) class, lambs were blocked into three age groups with each block assigned to a pen. Pen feed consumption and lamb weights were recorded every 28 d. Lambs were slaughtered when mean lamb weight in a pen reached 50 kg. The model for lamb average daily gain (ADG) included DB, SB, DBxSB, sire (SB) and block. Individual lamb carcass traits were analyzed with a similar model but with hot carcass weight added as a covariate. Analysis of pen feed efficiency (gain/feed, FE) used a similar model as ADG but with sire (SB) deleted. Lambs from Suffolk dams had greater (P<.05 or P<.10) ADG (318 vs 268 g), improved FE (.183 vs .165), less internal fat (KPH) (2.6 vs 2.8%), higher leg conformation scores (12.1 vs 11.4) and more desirable yield grades (YG) (3.07 vs 3.14) than lambs from Targhee dams. Differences (P<.05) among SB were observed for ADG and FE: FN- (350 g, .192) and C6-sired lambs (332 g, .187) were superior to SC- (330 g, .172) and BA-sired lambs (264 g, .178) with BM-sired lambs having the lowest values (223 g, .142). Differences (P<.05) were observed among the carcasses of lambs sired by FN, C6, BM, SC and BA sires for rib eye area (14.1, 15.0, 14.4, 14.7 and 17.1 cm^2), 12th rib fat thickness (.48, .48, .51, .61 and .46 cm), KPH (2.3, 2.1, 2.7, 3.3 and 3.3%) and YG (2.92, 2.85, 3.06, 3.46 and 3.09). Poor ADG, FE and carcass merit of F_1 ram lambs from sires of prolific breeds are overhead costs in the production of prolific F_1 ewes. These overhead costs would be highest with BM, intermediate for SC and BA and least for FN and C6 sires.

D. **Detection of the "F" Gene of the Booroola Merino in Prepubertal Ewe Lambs.** D. L. Thomas, T. G. Nash, P. J. Dziuk, R. M. Bunge, D. F. Waldron and C. P. Matos.

Backcrossing of the "F" gene into domestic populations would be greatly aided if the gene could be detected in prepubertal animals. On August 6, 1987, 5-month-old Booroola x Rambouillet (+F) and Rambouillet (++) ewe lambs were given an injection of either 500 i.u. of PMSG or 750 i.u. of hCG to induce ovulation. Corpora lutea were counted by laparoscopy 5 days after injection. The trial was repeated 16 days later with the ewe lambs re-randomized to treatments. Results of both replicates are presented in Table 4.

Table 4. Ovulation Response Following Injection with either 500 i.u. PMSG or 750 i.u. hCG

Treatment	No.	No. ovulating	No. ovulations/ewe Available	No. ovulations/ewe Ovulating	Ovulation dist. 0	1	2	3	4	5
Rep 1										
Booroola x Ramb. (+F)										
PMSG	13	9(69%)	1.69	2.44	4	2	3	2	2	0
hCG	14	4(29%)	.93	3.25	10	0	2	0	1	1
Rambouillet (++)										
PMSG	9	2(22%)	.33	1.50	7	1	1	0	0	0
hCG	14	5(36%)	.57	1.60	9	2	3	0	0	0
Rep 2										
Booroola x Ramb. (+F)										
PMSG	11	8(73%)	2.09	2.88	3	0	4	1	3	0
hCG	11	6(55%)	1.27	2.33	5	2	1	2	1	0
Rambouillet (++)										
PMSG	12	5(42%)	.50	1.20	7	4	1	0	0	0
hCG	11	5(45%)	.55	1.20	6	4	1	0	0	0

In both trials PMSG resulted in greater differences between the 2 breed groups than did hCG, and would be the choice of hormone treatments to detect the presence of the "F" gene in prepubertal ewe lambs. If ovulation after an injection of PMSG was the criterion for presence of the "F" gene, 71% of the Booroola x Rambouillet ewe lambs would have been classified correctly as carriers (69% in rep 1 and 73% in rep 2) and 68% of the Rambouillet ewe lambs would have been classified correctly as non-carriers (78% in rep 1 and 58% in rep 2). If the criterion for presence of the "F" gene was changed to 2 or more ovulations after injection with PMSG, the percentage of correct classifications for carriers among the Booroola x Rambouillet ewe lambs would decrease slightly to 64% (54% in rep 1 and 73% in rep 2), but the percentage of correct classifications for noncarriers among the Rambouillet ewe lambs would increase substantially to 90% (89% in rep 1 and 91% in rep 2). The choice of criterion would depend upon whether you wished to maximize the proportion of "F" gene carriers retained or minimize the proportion of noncarriers retained.

E. **Analysis of reproduction in a Rambouillet Flock.** R. M. Bunge, D. L. Thomas, T. G. Nash, D. F. Waldron and J. M. Stookey.

Data were analyzed from the Rambouillet flock at Dixon Springs Agricultural Center (DSAC) for lambing in 1983, 1984 and 1985. Number of ewes exposed in the fall of 1982, 1983 and 1984 were 238, 244 and 249, respectively. Approximately 25 seven month old ram lambs were used each year.

Traits analyzed were ovulation rate (determined by laparoscopy), fertility (ewes lambing/ewe exposed), prolificacy (number of lambs born/ewe lambing), lamb survival (number of lambs weaned/lambs born) and total kgs. of lamb weaned/ewe exposed. Heritabilities and repeatabilities of these traits are presented in Table 5.

Table 5. Heritabilities and Repeatabilities for Reproductive Traits.

Item	h^2	$\pm$ s.e.	r	$\pm$ s.e.
Ovulation rate	.47	$\pm$.17	.30	$\pm$.05
Fertility	.03	$\pm$.04	.03	$\pm$.04
Prolificacy	.34	$\pm$.19	.19	$\pm$.08
Lamb survival	.15	$\pm$.11	.08	$\pm$.05
Kg lamb weaned/ ewe exposed	.14	$\pm$.39	.05	$\pm$.14

The effects of the following factors on these reproductive traits were determined: year, ewe and ram type of birth, ewe and ram hemoglobin type (Hb AA and Hb AB types were pooled because of very low frequency of Hb AA types), sex of lamb, ram weight at breeding, lambing date and condition score and age at breeding. Several significant interactions of factors with year were found so analyses were done within year. However, the results presented in Table 6 have been pooled across years.

Table 6. BLUE's and Regression Coefficients for Factors Affecting Reproductive Traits in Rambouillet Sheep.

Factors	Ovulation rate	Fertility	Prolificacy	Lamb survival	Kg lamb weaned/ ewe exposed
Ewe birth type					
Single	1.63	.62	1.33	.82	10.01
Multiple	1.61	.63	1.33	.78	10.10
Ewe hemoglobin					
Hb AA & AB	1.65	.65	1.30	.80	10.10
Hb BB	1.60	.61	1.37	.79	10.01

Table 6. (Continued)

Factors	Ovulation rate	Fertility	Prolificacy	Lamb survival	Kg lamb weaned/ ewe exposed
Ram birth type	†	**		*	
Single	1.58	.70	1.35	.84	11.84
Multiple	1.69	.55	1.31	.76	8.26
Ram hemoglobin	†				
Hb AA & AB	1.58	.65	1.30	.80	10.00
Hb BB	1.66	.60	1.37	.79	10.11
Lamb sex				*	
Ewe	----	----	----	.83	----
Ram	----	----	----	.77	----
Regressions					
Ewe wt. (Kg)	.017*	.003†	.014	.001	.188
Ewe cond. score	-.015	.040	.009	.049	1.213
Ewe age (yr)	.080	.014	.209†	.139	2.544
$(\text{Ewe age})^2$	-.005	-.002	-.118	-.017	-.263
Ram wt. (Kg)	.003	.003*	-.007	-.005	.029*
Lambing date	----	----	-.000	-.001	----

†P<.10, *P<.05, **P<.01

F. **Heritabilities and Factors Affecting Scrotal Circumference at Different Ages in Rambouillet Ram Lambs.** C. P. Matos, D. L. Thomas, T. G. Nash, D. F. Waldron, R. M. Bunge and J. M. Stookey.

Scrotal circumference (SC) and live weight (LW) were collected over 6 yr (1982-1987) on 534 spring-born ram lambs (109 sires) from the Rambouillet flock at the Dixon Springs Agricultural Center. Scrotal circumference and LW were predicted at 5 different ages (90, 120, 150, 180, and 210 days) for each lamb using linear and quadratic regressions of a lamb's SC and LW on age at measurement. Factors affecting age-adjusted scrotal circumference and estimates of the heritabilities using the paternal half-sib method were determined. Two models were used. The relationship matrix among sires was taken into account in both models. Model 1 included year and type of birth as fixed effects; birth date nested within year, LW and LW^2 as covariates and sire nested within year as a random effect. Model 2 was similar to Model 1 but with LW and LW^2 excluded. Previous analyses of variance determined that age of dam, type of birth-rearing and all possible two-way interactions were not significant sources of variation.

The most relevant results are summarized in Table 7. The differences in SC due to type-of-birth seem to be mediated by live weight because when data is adjusted for body weight (Model 1), single- and multiple-born lambs only differ significantly (P<.01) at 90 days of age. When body weight is not taken into account (Model 2), multiple-born lambs have smaller SC at all ages, but the difference between birth types decreases with increasing age and was not significant at 210 d. The regression coefficients for LW and LW^2 were in general significantly different from zero indicating a quadratic increase in SC as LW increases.

The heritability of SC at different ages and corresponding standard errors are presented in the bottom of Table 7. The heritability estimates are moderate to high. There is a tendency for an increase in heritability with age. Also, adjustment for live weight led to a 0-58% increase in heritability.

Table 7. Marginal Means for Scrotal Circumference (cm) and Heritability Estimates.

Age (d)	90		120		150		180		210	
Model	1(+LW)	2(-LW)	1(LW)	2(-LW)	1(+LW)	2(-LW)	1(+LW)	2(-LW)	1(+LW)	2(-LW)
Type-of-birth										
Singles	14.7±.14a	15.5±.18[a]	20.0±.16	20.7±.24[a]	25.1±.16	25.6±.23[a]	30.0±.18	30.4±.22[a]	32.5±.35	32.7±.36
Multiples	15.2±.13[b]	14.6±.17[b]	20.3±.15	19.4±.25[b]	25.3±.15	24.5±.22[b]	30.3±.17	29.6±.21[b]	32.9±.30	32.6±.32
Regression coefficients										
LW(cm/kg)	0.15±.11		0.61±.13***		0.87±.13***		0.77±.14***		0.42±.24†	
LW^2	0.004±.002†		-0.002±.002		-0.005±.002***		-0.005±.001**		-0.002±.002	
h^2±se	.39±.18	.25±.17	.26±.15	.19±.15	.25±.14	.23±.14	.41±.17	.26±.16	.72±.28	.72±.28
No. of sires	97		106		109		108		59	
No. of obser.	417		502		534		473		223	

[a,b]P<.01
†P<.10, *P<.05, **P<.01, ***P<.001

G. **Reproduction of Hampshire Ewes Flushed With a High Protein Grain Mix and Injected With Fecundin.** D. L. Thomas, C. T. Walker, A. R. Cobb, D. F. Waldron, R. M. Bunge, C. P. Matos and R. J. Feltes.

A 2 x 2 factorial treatment design was used to study the effects of flushing and "Fecundin" on reproduction of 93 purebred Hampshire ewes maintained together on pasture prior to and during the fall mating season of 1987. Flushing treatments consisted of no supplemental grain or .45 kg per head per day of a grain mix containing 75% corn and 25% soybean meal fed from August 31 through October 1. Fecundin treatments were no injections or 2 injections of Fecundin; one on August 10 and the other on August 31. Intact rams were placed with the ewes on September 14 and laparoscopies were performed on ewes 3 to 10 days after mating to determine ovulation rate. Results are presented in Table 8.

Table 8. Effects of Flushing and Fecundin on Reproduction of Hampshire Ewes

Treatments	No. lapped	Ovulation rate	No. at lambing	Fertility, %	Prolificacy	Lambs/ exposure
Control	23	2.28[b,c]	23	80.2	1.59[a,b]	1.29
Fecundin	24	2.51[a,b]	22	91.4	1.53[a,b]	1.39
Grain	24	1.87[c]	23	87.3	1.46[b]	1.28
Fecundin + grain	22	2.92[a]	22	88.7	1.88[a]	1.64
Main effects						
Fecundin		+.65**		+6.3	+.17	+.23
Grain		-.00		+2.2	+.11†	+.12
Interaction		**		N.S.		N.S.

[a,b,c]P<.05, N.S. = nonsignificant, †P<.10, **P<.01.

Injection of Fecundin resulted in .65 more ($P<.01$) eggs ovulated, 6.3% more (N.S.) ewes lambing, .17 more (N.S.) lambs per ewe lambing and .23 more (N.S.) lambs per ewe exposed. The effects of the grain flushing were smaller than those of Fecundin and always nonsignificant. There was a significant interaction between Fecundin and flushing treatments for ovulation rate and prolificacy. This was due to the greater response to Fecundin of ewes supplemented with grain compared with those not supplemented.

II. Publications

A. Journal Articles

DeHaan, K. C., L. L. Berger, D. J. Kesler, F. K. McKeith, D. L. Thomas and T. G. Nash. 1987. Effect of prenatal androgenization on lamb performance, carcass composition and reproductive function. J. Anim. Sci. 65:1465-1470.,

Waldron, D. F., D. L. Thomas, T. W. Wickersham, D. G. Morrical, S. R. Baertsche, R. E. Hudgens, C. W. Hirschinger and R. A. Kemp. 1988. Central ram tests in the Midwestern United States. I. Description and estimation of performance trends. J. Anim. Sci. (Accepted).

Waldron, D. F., D. L. Thomas, T. W. Wickersham, D. G. Morrical, S. R. Baertsche, R. E. Hudgens, C. W. Hirschinger and R. A. Kemp. 1988. Central ram tests in the Midwestern United States. II. Factors affecting test performance and sale price of tested rams. J. Anim. Sci. (Accepted.)

B. Proceedings

Thomas, D. L., A. R. Cobb and D. F. Waldron. 1988. Spider syndrome - a genetic defect found in American Suffolk sheep. Proc. IIIrd World Cong. on Sheep and Beef Cattle Breeding. Paris, France. (Accepted).

PURDUE UNIVERSITY

1988 ANNUAL REPORT TO NC-111

OBJECTIVE 1 of NC-111; Increase the efficiency of reproduction and growth in sheep.

A. Influence of melatonin on serum progesterone concentrations during the luteal phase of the estrous cycle of mature ewes. L.M.F. Aguiar and R.E. Hudgens.

1. Objectives:

   a. To determine if exogenous melatonin influences production of serum progesterone during the luteal phase of the estrous cycle.
   b. To determine if progesterone is secreted in a circadian pattern during the luteal phase of the estrous cycle.

Twenty mature, cycling Suffolk cross ewes were randomly allotted to one of two treatments. Treatments were: 1) 2 mg melatonin dissolved in 30 ml of water and administered orally each day at 4 pm (N=10); 2) 30 ml of water administered orally each day at 4 pm to controls (N=10). Melatonin administration began on September 1 and continued until termination of the project on October 12.

The estrous cycle of all ewes was synchronized by injecting 20 mg of PGF_2 i m on 9-10 followed by a second injection on 9-21. All but one ewe was in estrus on 9-23. Day of estrus was considered day 0 of the estrous cycle.

On days 7 and 14 of the synchronized estrous cycle, blood samples were collected at 2-hour intervals on the even hours for 24 hours. These samples were analyzed for concentrations of progesterone.

Results of the two 24-hour bleedings are shown in Table 1. Progesterone concentrations were not different ($P<.05$) between treatments nor did time of sample collection influence progesterone values on day 7 of the estrous cycle. On day 14 of the estrous cycle administration of melatonin significantly ($P<.05$) increased serum progesterone compared with controls. Time of sample collection did not influence progesterone concentrations ($P<.05$).

Table 1. Serum progesterone concentrations during 24 hours in ewes administered melatonin.

Treatment	Day 8 AM-6 PM	Night 8 PM-6 AM	Total
	Day 7 of the Estrous Cycle		
Control	2.6 ± .08	2.5 ± .09	2.5 ± .06
Melatonin	2.4 ± .07	2.4 ± .09	2.4 ± .06
Total	2.5 ± .05	2.5 ± .06	
	Day 14 of the Estrous Cycle		
Control	2.8 ± .15[a]	2.5 ± .17[a]	2.6 ± .11[a]
Melatonin	3.4 ± .14[b]	3.2 ± .16[b]	3.3 ± .10[b]
Total	3.1 ± .10	2.8 ± .11	

Progesterone (ng/ml)

[a,b]Column means within day with different superscript differ (P<.05).

B. Influence of melatonin on serum progesterone concentrations during early pregnancy and lambing performance in mature ewes.

1. Objectives:

   a. To determine if exogenous melatonin influences production of serum progesterone during early pregnancy.
   b. To determine if exogenous melatonin will increase the number of lambs born.

Seventy-six mature cycling ewes were randomly allotted to one of two treatments: 1) Control (N=37), 2) 2 mg melatonin administered orally each day at 4 pm (N=39).

Two fertile rams were placed with the ewes 15 days after melatonin administration had begun. The ewes received a daily oral dose of 2 mg of melatonin dissolved in 30 ml of water at 4 pm beginning September 17.

Blood samples were collected twice weekly from each ewe until 7 consecutive samples were obtained. Sampling began after a mark on the ewe was detected from a ram equipped with a ewe marking harness. Serum from these samples was harvested and assayed for progesterone content.

The overall mean progesterone concentration was higher (P<.05) for ewes receiving melatonin during early pregnancy than for control ewes (3.5 ± .09 vs 3.2 ± .09 ng/ml). However, number of ewes lambing, date of lambing, number of lambs born per ewe lambing or per ewe exposed was not different (P<.05) between treatments.

OBJECTIVE 2 of NC-111. Develop feeding strategies for high-producing sheep.

A. Growth and reproductive performance of ewe lambs supplemented with corn or soybean meal while grazing pasture. R.A. Yoder, R.E. Hudgens, T.W. Perry and K.D. Johnson.

Fifty-nine Suffolk-cross ewe lambs, approximately three months of age were assigned at random by weight strata to one of three treatments on May 27: 1) pasture only (N=20). 2) pasture plus .2 pound soybean meal per head per day (N=20), and 3) pasture plus 1.0 pound whole shelled corn per head per day (N=19). All ewes were managed as one group on predominantly tall fescue and Kentucky bluegrass pasture except for a brief daily supplementation period. At 7:00 a.m. each day ewes were moved to a corral, sorted and fed their respective supplement.

Body weights, measurements and condition scores were taken on each ewe at monthly intervals. Blood samples were collected from all ewes twice weekly from July to October for progesterone analysis. Concentrations of progesterone greater than 1 ng/ml were used to predict the formation of a corpus luteum and therefore an indication that puberty had occurred. In mid-August, two vasectomized rams, fitted with ewe marking harnesses were placed with the ewes to detect outward signs of estrus. On October 1, the vasectomized rams were replaced by two fertile Suffolk rams. The fertile rams remained with the ewes until November 20, a 51-day breeding period.

All ewe lambs were moved off pasture after the breeding period and fed an identical diet of alfalfa haylage plus corn. All ewe lambs were managed as one group through gestation and lactation.

At the onset of the experiment, body measurements were similar among treatments. By the end of the breeding period ewes fed corn were larger than ewes in the control group or ewes fed soybean meal. None of the reproductive traits measured were different among treatments. While ewe lambs supplemented with corn had larger body measurements by the end of breeding, this difference did not result in an advantage in reproductive performance compared with non-supplemented ewe lambs. This lack of difference may be explained, in part, by the fact that lambs can selectively graze pastures and therefore consume a high quality diet.

Publications:

Hudgens, R.E., T.G. Martin, M.A. Diekman and S.L. Waller. 1987. Reproductive performance of Suffolk and Suffolk-cross ewes and ewe lambs exposed to vasectomized rams before breeding. J. Anim. Sci. 65:1173-1179.

Hudgens, R.E., T. Leakakos, S.L. Waller, G.R. Kelly and G.E. Moss. 1987. Reproductive performance of fall and winter lambing ewes and growth of their offspring. SID Research Digest. Vol. 3, No. 3:11-13.

Waller, S.L., R.E. Hudgens, M.A. Diekman and G.E. Moss. 1988. Effect of melatonin on induction of estrous cycles in anestrous ewes. J. Anim. Sci. 66:459-463.

Iowa State University
1988 Station Report to NC 111

"Increased Efficiency of Sheep Production"

I. Objective 1 of NC 111: Develop methods for utilization of genetic variation among and within breeds.

A. Roto-Terminal versus 2 breed rotation for commercial sheep production. D.G. Morrical, R.A. Willham and C.F. Webb.

This project utilizes a maternal breed (Polypay) and dual purpose breed(Dorset) in the roto-terminal cross with terminal sire breed (Suffolk). The two breed rotation utilizes Dorset and Suffolk breeds. The main objective being to evaluate the effect of a maternal breed on post weaning performance of Suffolk sired lambs. Figure 1 is a schematic representation of the crossing systems. Table 1 includes growth and feed efficiency for F2 and F3 lambs produced in 1987 and 1988. Table 2 includes a limited number of production characteristics being evaluated on the ewes from the above mentioned crosses.

All lambs received a 17% crude protein, 82% TDN ration composed of shelled corn and pelleted protein supplement. Lambs were full fed and received no roughage source except bedding. Feeding trials were for 49 days.

Feedlot performance of all groups was excellent with no differences observed among crosses. The majority of F2's were ram lambs and F3's were an equal mix of each sex. It appears from the two years of data that inclusion of a maternal breed in a roto terminal crossing system does not affect post weaning performance. Lambs produced in 1989 by this cross breeding study will be evaluated to complete this portion of the study.

Selected production characteristics of F1 ewes are displayed in table 2. Ewes will be evaluated through 5 years of age for the various production characteristics. Preliminary analysis indicates a year by breed group interaction. Suffolk sired F1 females were always heavier than Dorset or Polypay sired females at breeding. Conception rates were lower for Suffolk sired females at one year of age compared to Polypay or Dorset sired females. Lambing rate was not affected by breed of sire for ewes lambing at 1 or 2 years of age. Polypay and Dorset sired ewes had higher lambs born per ewe lambing at 3 and 4 years of age compared to Suffolk sired ewes. Polypay ewes also had higher lambing rates than Dorsets at 4 years of age.

Production characteristics for F2 females are shown in table 3. Females in the roto terminal system weighed less at breeding compared to those in the 2 breed rotation at 1 and 2 years of age. Conception rates were not affected by crossing system. Suffolk X Dorset ewes had lower lambing rates than Polypay X Dorset females at one year of age.

These parameters will continue to be monitored through 5 years of production. Other parameters will include days from exposure to lambing and wool production.

II. Objective 3: Develop and evaluate production techniques and management systems to improve biological and economical efficiency of lamb and wool production.

A. Sequential grazing of steers and ewes. M.A. Sanderson, W.F. Wedin and D.G. Morrical.

A system of grazing steers and mature ewes in sequence (steers as first grazers, and ewes as last grazers) was compared with grazing steers and ewes separately in 1986 and 1987 at the Shelby-Grundy Research Center in southern Iowa. Pastures were stocked initially at two steers per acre. Pastures continuously grazed by ewes were stocked at 7 ewes per acre. Animal numbers were varied during the season to match available forage. On the sequentially grazed pastures, the ratio of ewes following steers was maintained at 2:1. Yield of green dry matter (GDM), botanical composition, and sward height were recorded in 1987. Average daily gain of steers grazed sequentially were superior to gains of continuously grazed steers in both years (1.7 lb. per day vs. 1.2 lb. per day, averaged over years). Liveweight gains per acre were greater from the continuous grazing system in 1986 (223 vs. 147 lb. per acre), but both systems produced similar liveweight gains in 1987 (180 lb. per acre). We conclude that the sequential grazing system results in a more efficient use of pasture by allowing steers to use high quality pasture first and maintaining ewes on the residual forage after steers have grazed.

Future Plans

Attached to this report are plans for a new sheep research facility. This facility will be located approximately 75 miles south, southeast of Ames on the McNay Memorial Outlying Research Center.. Scheduled date of completion will be October of 1988. With the research flock being moved to this location in November.

Continued evaluation of the cross breeding systems will continue. Definite plans for other research activities will not be finalized until the flock is established at the new unit.

Publications

Morrical, D.. 1988. Crude protein level of creep feed as it affects preweaning lamb performance. 1988 Beef-Sheep Research Report AS-588:28.

Morrical, D. and R. Al Tamini. 1988. The affect of breed cross on birth weight and weaning weight of lambs. 1988 Beef-Sheep Research Report AS-588:9.

Sanderson, M., F. Wedin and D. Morrical. 1988. Sequential grazing of steers and ewes. 1988 Beef-Sheep Research Report AS-588:31.

Raif Al Tamimi, 1987. The effect of the sire breed of the ewe on the birth weight and weaning weights of her crossbred lambs, M.S. Thesis, Iowa State University

Waldron, D.F., D.L. Thomas, T. Wickersham, D.G. Morrical, S.R. Baertsche, R.E. Hudgens, C.W. Hirshinger, R.A. Kemp. Central Ram Test in Midwestern U.S. 1. Description and estimation of performance trends. J. Anim. Sc. approved with revisions.

Waldron, D.F., D.L. Thomas, T. Wickersham, D.G. Morrical, S.R. Baertsche, R.E. Hudgens, C.W. Hirshinger and R.A. Kemp. Central Ram Tests in Midwestern U.S. 2. Factors affecting test performance and sale price of tested rams.

Wilson, D. and D. Morrical. 1988 National Sheep Improvement Program Development. 1988 Beef-Sheep Research Report AS-588:7.

Figure 1. Schematic representation of the roto-terminal and two breed rotation crossbreeding.

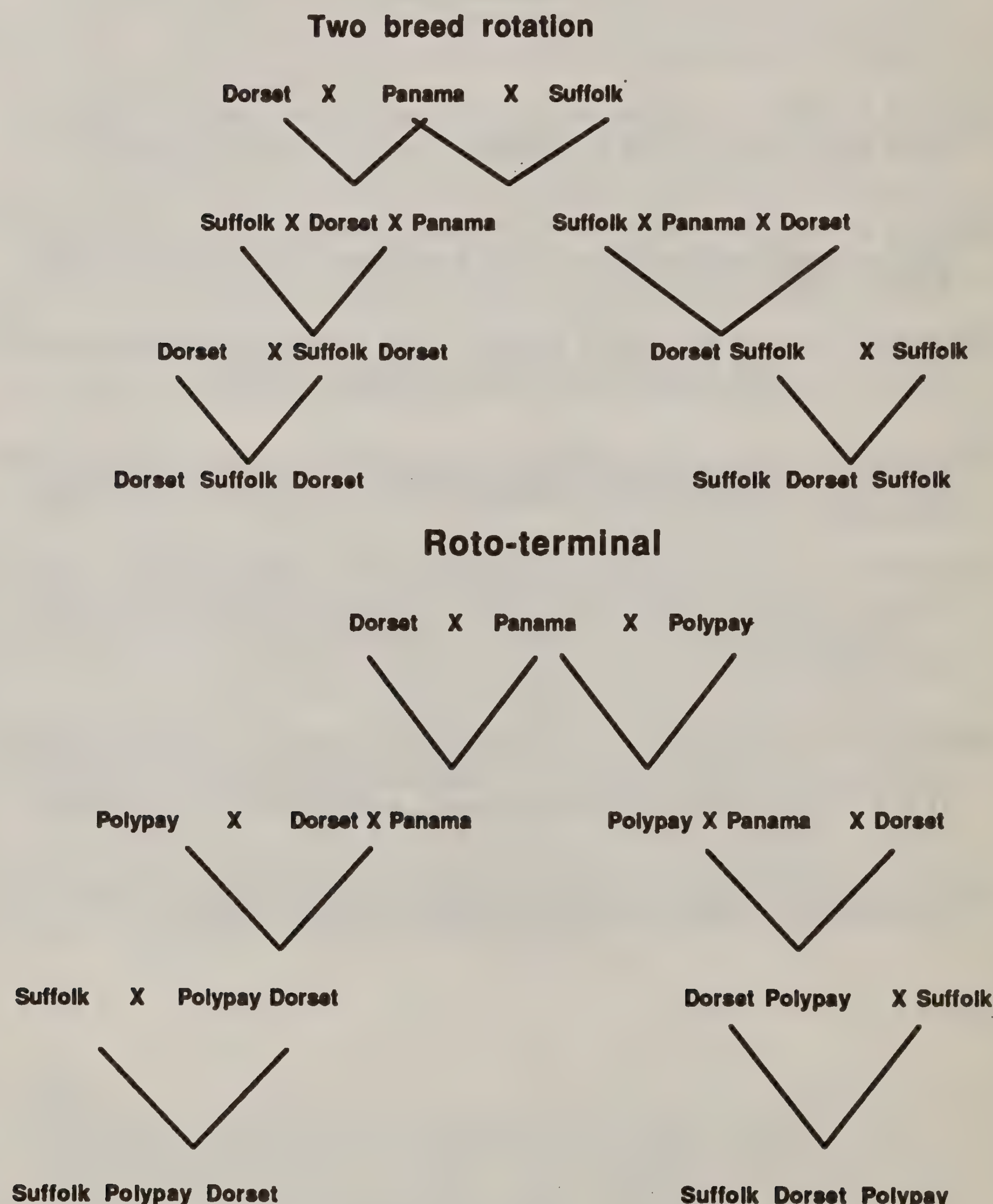


Table 1. Postweaning Performance of F2 and F3 Progeny[a].

F2's	ADG 1987	ADG 1988	FE 1987	FE 1988
Dorset*Polypay Polypay *Dorset	.97	.75	3.82	4.33
Dorset*Suffolk Suffolk*Dorset	1.01	.80	3.50	4.19
F3's				
SuffolkXDorPol SuffolkXPolDor	1.02	.83	3.36	3.71
SuffolkXDorSuf DorsetXSufDor	.96	.78	3.40	4.09

[a] Means within columns for F2's and F3's do not differ. (P>.10)

Table 2. Production Characteristic of F1 Crossbred Ewes

Breeding Weight (lbs)

Breed type:	Age (yr) 1	2	3	4
Dorset x Panama	102[c]	141[c]	170[c]	181[c]
Polypay x Panama	102[c]	145[c]	174[c]	185[c]
Suffolk x Panama	113[d]	156[d]	183[d]	193[d]

Conception Rate (%)

Breed type:	1	2	3	4
Dorset x Panama	88[a]	83	88	77
Polypay x Panama	83[e]	90	93	84
Suffolk x Panama	68[b,f]	76	89	83

Lambs Born per Ewe Lambing

Breed type:	1	2	3	4
Dorset x Panama	1.25	1.74	2.03[c]	2.05[a]
Polypay x Panama	1.23	1.69	2.33[b]	2.50[b,d]
Suffolk x Panama	1..33	1.54	1.81[b,d]	2.00[c]

[ab] Means within columns with different superscripts differ (P<.01)

[cd] Means within columns with different superscripts differ (P<.05)

[ef] Means within columns with different superscripts differ (P<.10)

Table 3. Production Characteristics of F2 Crossbred Ewes

Breeding Weight (lbs)

Breed type:	AGE (yrs) 1	2	3
Dorset x Polypay	103^{a}	141^{a}	174
Polypay x Dorset	100^{a}	142^{a}	161
Suffolk x Dorset	114^{b}	156^{b}	186
Dorset x Suffolk	115^{b}	149^{b}	172

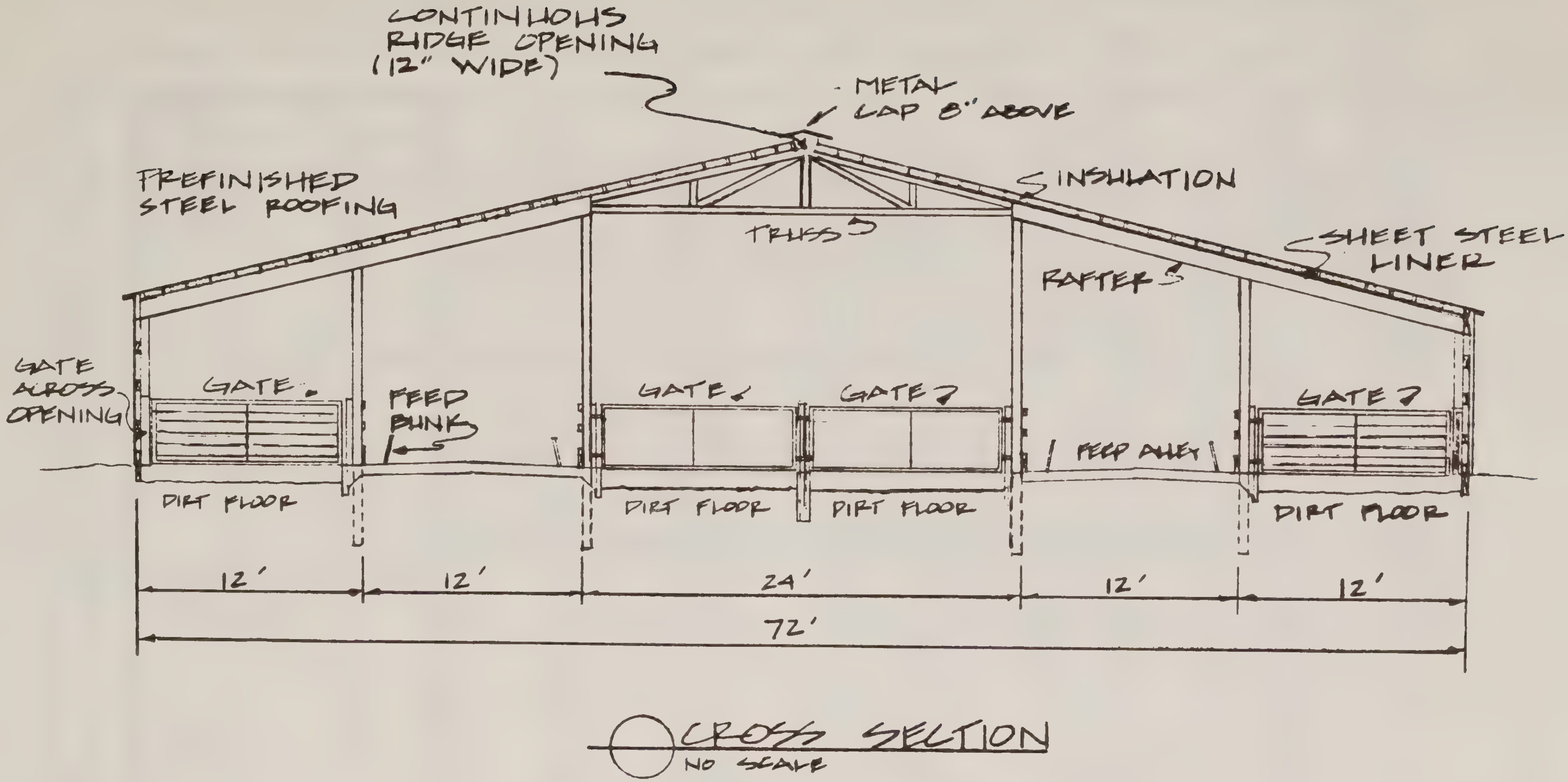
Conception Rate (%)

Breed type:	1	2	3
Dorset x Polypay	75	93	89
Polypay x Dorset	81	83	100
Suffolk x Dorset	81	86	100
Dorset x Suffolk	83	89	100

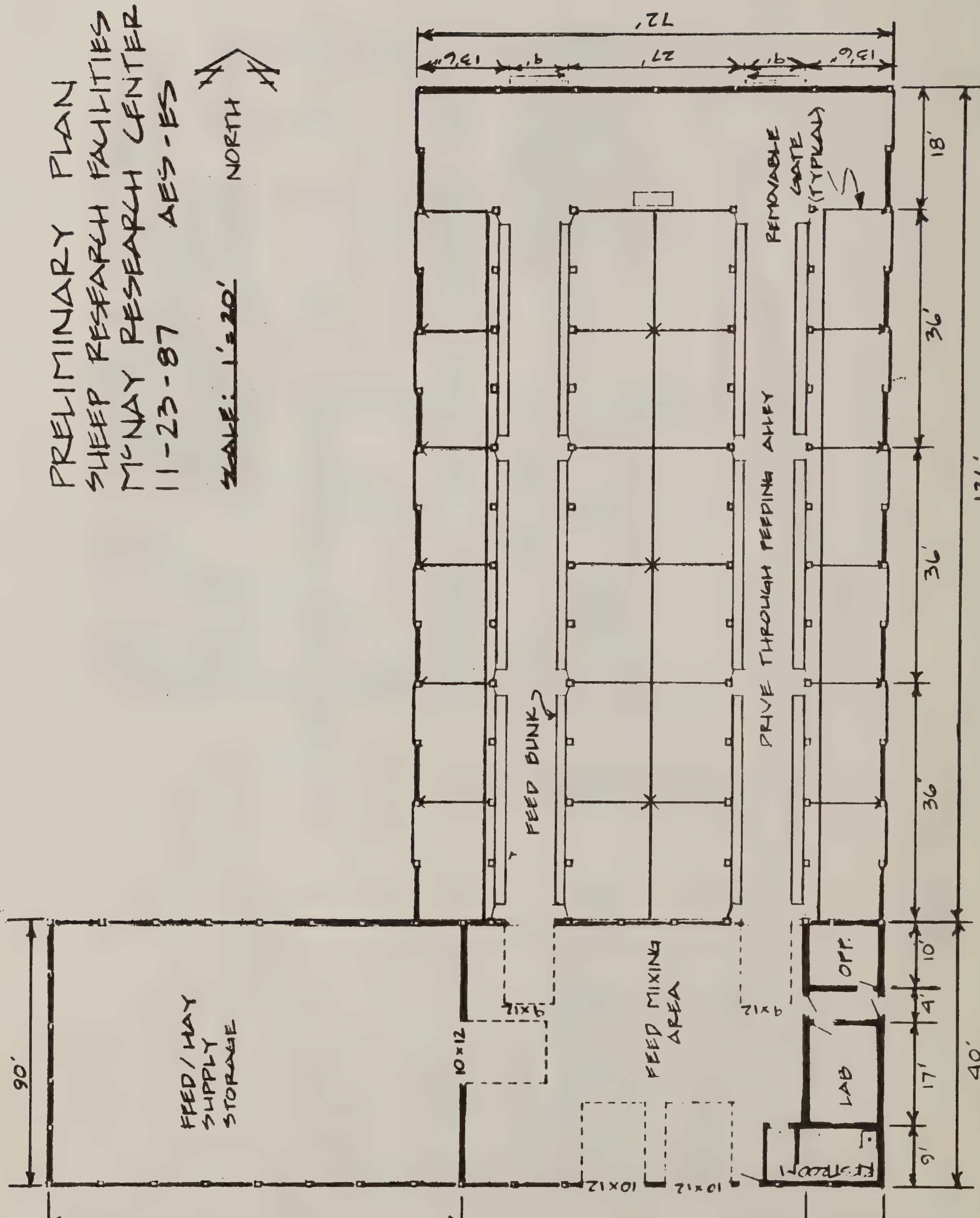
Lambs Born per Ewe Lambing

Breed type:		
Dorset x Polypay	$1.43^{a,b}$	1.86
Polypay x Dorset	1.60^{a}	1.33
Suffolk x Dorset	1.18^{b}	1.50
Dorset x Suffolk	1.62^{a}	1.75

ab Means within columns differ ($P<.05$)



PRELIMINARY CROSS-SECTION
SHEEP FACILITIES
McNAY RESEARCH CENTER
11-23-87 AES-ES


PRELIMINARY PLAN
SHEEP RESEARCH FACILITIES
McNAY RESEARCH CENTER
11-23-87 AES-ES
SCALE: 1"=20'
NORTH
72'
13'6"
9'
27'
9'
13'6"
18'
36'
36'
36'
126'
REMOVABLE GATE (TYPICAL)
DRIVE THROUGH FEEDING ALLEY
FEED BUNK
FEED/HAY SUPPLY STORAGE
FEED MIXING AREA
9x12
9x12
10x12
10x12
10x12
OFF.
LAB
RESTROOM
10'
4'
17'
9'
40'
90'
64'
52'
12'
128'

Kansas State University
1988 Station Report to NC-111

I. Objective 1: Increase the efficiency of reproduction and growth in sheep.

A. Coordinated Booroola Merino Project
(Frank J. Schwulst)

The first group of Booroola x Rambouillet, Finn x Rambouillet and straight Rambouillet ewe lambs was born in the fall of 1986. Twenty-eight Booroola cross, 25 Finn cross and 35 Rambouillet ewe lambs were retained to be evaluated as F_1 ewes.

At nine months of age, Booroola cross ewe lambs weighed 95.4 pounds compared with Finn crosses at 119.9 pounds and 119.4 pounds for Rambouillet ewe lambs. The quantity of wool produced was similar for the three breed groups at 7.95, 7.04, and 7.87 pounds, respectively. Though no quality measurements were made, the Booroola cross wool appeared to be finer than that produced by the Finn crosses and straight Rambouillets.

One Rambouillet ewe lamb died before breeding began in September 1987. A greater percentage of Rambouillet ewe lambs cycled, with an advantage of 9.1% and 15.2% over the Booroola crosses and Finn crosses, respectively.

Ovulation rate was evaluated by laparoscopy. Corpus luteum count was highest for the Booroola crosses at 2.2, an increase of 37.5% and 57.1% over the Finn and Rambouillet groups, respectively.

The ewes lambed for the first time in February 1988. Those data are not yet summarized.

Estrus and Ovulation Data for F_1 Ewe Lambs

Breed	No. Exposed	Ewes Cycled	% 82.1	No. Corpus Luteum
Booroola	28	23	82.1	2.2
Finn	25	19	76.0	1.6
Rambouillet	34	31	91.2	1.4

II. Objective 2: Develop feeding strategies for high producing sheep.

A. Ammoniated Wheat Straw and Aflalfa Separately and Combined in Diets for Ewes
(Frank J. Schwulst, Seyed Azimi and Keith Bolsen)

In late January 1987, 164 crossbred ewes were assigned to one of three treatments. The ewes ranged from 3 to 9 years of age, and all were Rambouillet crosses with the Dorset, Finn, or Suffolk breeds.

The ammoniated wheat straw and alfalfa were fed in the form of whole, big, round bales, two at a time. One group (S) was fed two ammoniated straw bales, supplemented with a half-pound of grain sorghum per head per day. The second group (S-A) received one straw and one alfalfa bale, and the third group (A) was fed two alfalfa bales at a time.

Neither the S-A nor A group received grain sorghum. The straw and alfalfa supplies of each group were replenished only when both bales were entirely consumed.

Breeding occurred from mid-May through June. All groups were supplemented with a pound of grain sorghum per head per day during the flushing period, which extended from May 1 through mid-June. The ewes were weighed monthly through September and were condition scored in January, April, June, and September. After weighing in mid-September, treatment rations were stopped, and all ewes were fed a standard prelambing ration consisting of corn silage, alfalfa, and grain sorghum. Lambing occurred in October and November.

The straw-fed ewes essentially maintained weight throughout the duration of the trial. The S-A ewes generally gained throughout the feeding period, reaching an average of nearly 146 pounds by September. The alfalfa-fed ewes gained at the fastest rate, weighing nearly 173 pounds or almost 50 pounds more than the straw-fed ewes by the end of the 7-month trial.

The alfalfa-fed ewes produced 8.8 pounds of wool each, compared with 8.7 pounds for the S-A ewes and 7.6 pounds for the straw-fed ewes. The wool of all ewes was severely contaminated by vegetable matter from the straw and alfalfa.

Average initial condition score was about 4 for each group, indicating that all ewes were in good condition at the start of the trial.

The condition score of the S-A group remained very stable during the course of the experiment. As the alfalfa-fed ewes gained weight during the 7-month period, their average condition score increased accordingly, over 2 points from January to September. Condition scores of the straw-fed ewes decreased steadily, reaching a low of 3.1 in September. There appeared to be no diet effect on conception rate, since better than 90% of the exposed ewes lambed in all treatment groups.

Lamb crop size was markedly higher for ewes fed alfalfa or the combination of alfalfa and ammoniated wheat straw. The advantage for the alfalfa-fed ewes over the S-A and S groups was 14.3% and 26.9%, respectively. The S-A ewes produced a 12.6% greater lamb crop than the S group.

III. Publications

Schwulst, F. J., J. E. Minton and D. D. Simms. 1987. Feedlot Performance and Prolactin Response of Lambs to Supplemental Lighting. S.I.D. Research Digest. 4(1):17.

Kansas Sheep Research. 1988. Report of Progress 540. Kansas State University Agricultural Experiment Station.

UNIVERSITY OF KENTUCKY
1988 Station Report to NC-111
Donald G. Ely

I. Project Title: Increasing Prolificacy in Sheep and Its Impact on Nutritional Needs.

II. Objective 2: Develop feeding strategies for sheep with high productive rates.

1. Experiment 1: Two diets containing either normal linseed meal (NLSM) or normal soybean meal (NSBM) were mixed with other dietary ingredients, except beef tallow, in a horizontal mixer. After 12 min mixing, liquid beef tallow (white choice grease) was added. Another 12-min mixing period followed.

   Tallow coated linseed meal (TLSM) and soybean meal (TSBM) supplements were prepared by mixing liquid tallow with LSM and SBM in a horizontal mixer at a ratio of 1:3.33 or 1:2.44, respectively. After a 12-min mix time, TLSM and TSBM were stored in paper bags at 5°C for 3 d. Then, the tallow coated protein was mixed with other ingredients for 12 min.

   All diets contained 80% concentrate (primarily ground corn) and 20% roughage (cottonseed hulls). Chemical analyses of the diets are presented in Table 1.

TABLE 1. CHEMICAL ANALYSES OF DIETS CONTAINING TALLOW COATED PROTEIN

Protein source	LSM		SBM	
Tallow treatment	N	T	N	T
Dry matter, %	91.0	92.2	92.2	92.0
Dry matter components, %:				
Acid-detergent fiber	16.9	16.3	14.6	11.7
Acid-detergent lignin	5.7	5.1	3.7	3.1
Ash	6.0	5.4	5.9	6.5
Crude protein	13.8	14.9	13.4	14.1

Twenty crossbred wether lambs (40 kg, 8 mo old) were randomly assigned to the diets in a 2x2 factorial arrangement of treatments. Each lamb was offered 500 g of its assigned diet twice daily. A 14-d diet and digestion crate adjustment period was followed by a 7-d fecal and urine collection period.

Digestibility of dietary nutrients is shown in Table 2. The effect of tallow coating on DM digestion was greater with SBM. Although ADF digestibility was higher, ash and CP coefficients were lower ($P<.05$) with LSM. Tallow coating increased DM, ash and CP digestibility, but lowered ADF digestion.

TABLE 2. NUTRIENT DIGESTIBILITY IN LAMBS FED DIETS WITH TALLOW COATED PROTEIN

Protein source	LSM		SBM	
Tallow treatment	N	T	N	T
DM[a]	73.0	73.6	74.0	76.6
ADF[a,b]	21.6	19.9	21.7	11.6
ASH[a,b]	57.4	52.1	60.4	66.7
CP[a,b]	69.3	72.2	67.6	69.8

[a]Significance ($P<.1$) N vs. T.

[b]Significance ($P<.05$) LSM vs. SBM.

Efficiency of nitrogen (N) usage is shown in Table 3. Differences in N retained (g/d) may reflect differences in dietary N intake. Still, when lambs were fed tallow coated protein, either as LSM or SBM, more ($P<.05$) N was retained (% of intake and % of digested).

TABLE 3. USE OF DIETARY N IN LAMBS FED DIETS WITH TALLOW COATED PROTEIN

Protein source	LSM		SBM	
Tallow treatment	N	T	N	T
N retained, g/d[a,b]	8.3	9.8	7.0	7.7
N retained, % of intake[a]	41.3	44.6	35.6	37.3
N retained, % of digested[a]	59.6	61.8	52.7	53.5

[a]Significance (P<.05) N vs. T.

[b]Significance (P<.05) LSM vs. SBM.

2. Experiment 2: Twenty-four crossbred lambs (37 kg at 7 mo of age) were assigned to four; 90% concentrate 10% roughage diets. Dietary treatments were 0, 5, 10 or 20% substitution of a by-product feed mixture for ground corn, shelled corn and soybean meal so all diets were isonitrogenous and isocaloric. The by-product mixture was composed of brewers grains, animal tallow, molasses and corn fermentation solubles. This by-product mixture contained 84% DM, 17% CP (DM basis) and 100% TDN (DM basis). Lambs were fed these diets ad libitum in individual pens for 42 d.

   Daily gains, daily feed intakes and feed efficiencies are shown in Table 1. Higher levels of the by-product feed (10 and 20%) produced slower, less efficient gains during the first 14 d of the study. The same results were found during the 14 to 28 and 28 to 42-d periods with the 20% level. The reduced gains, and resulting poor feed efficiencies, are attributed to reduced feed intake when this level was fed. However, use of the 10% diet increased dramatically during these periods.

TABLE 1. ADG, DFI AND FE OF LAMBS FED A BY-PRODUCT FEED MIXTURE

By-product level, %	0	5	10	20
0 to 14 d:				
ADG, kg	.18	.30	.14	.15
DFI, kg[a]	1.59	1.61	1.40	1.24
FE, kg/kg	8.75	5.37	11.67	8.27
14 to 28 d:				
ADG, kg[b]	.22	.25	.28	.18
DFI, kg	1.64	1.59	1.61	1.50
FE, kg/kg	7.45	6.36	5.75	8.33
28 to 42 d:				
ADG, kg[c]	.32	.22	.31	.25
DFI, kg	1.81	1.60	1.74	1.63
FE, kg/kg	5.66	7.27	5.61	6.52
0 to 42 d:				
ADG, kg[b]	.24	.25	.29	.19
DFI, kg	1.81	1.60	1.51	1.47
FE, kg/kg	7.56	6.40	5.21	7.71

[a]Linear effect ($P<.1$).

[b]Quadratic effect ($P<.1$).

[c]Cubic effect ($P<.1$).

Overall, daily gains increased with by-product substitution up to the 10% level (0 to 42 d), but were 33% lower with the 20% level. Daily feed intake dropped as the level of by-product in the diet increased. Consequently, lambs fed the 10% by-product diet required only 69% as much feed to produce each unit of gain as the control lambs consuming no by-product mixture.

Gain and feed efficiency of lambs in drylot can be significantly improved by substituting a by-product feed mixture of brewers grains, beef tallow, molasses and corn fermentation solubles for 5 to 10% of dietary corn and soybean meal.

III. Publications

A. Miscellaneous reports

Ely, D.G. and W.P. Deweese. 1987. Performance of lambs supplemented with lipid coated protein. Sheeprofit Day Prog. Rpt. 304:11-12.

Kemp, J.D. and D.G. Ely. 1987. A comparison of lamb growing finishing diets. Sheeprofit Day Prog. Rpt. 304:12-13.

University of Minnesota

1988 Annual Report to NC-III

Principal leaders and cooperating personnel: W.J. Boylan, R.M. Jordan, H.E. Hanke, G.C. Martin, R.A. Robinson, W.E. Rempel, and H.F. Windels.

I. Objective 1 of NC-III: To develop methods for utilization of genetic variation among and within breeds.

A. Crossbreeding and Lamb Growth (S.Y. Abboud and W.J. Boylan)

This study was initiated to investigate the effectiveness of selection for crossbred performance by intra-population vs. selection for combining ability. Data were collected on 212 sires producing 4,900 lambing records. Each sire produced purebred and crossbred contemporary half-sib lambs. Birth weight, weaning weight, pre-weaning average daily gain, post-weaning average daily gain and age at market weight are the traits under investigation. Primary analysis indicated that all pooled estimates of heritability for growth traits from purebred matings are small and not different from zero. Estimates of h^2 from crossbred data tended to be larger for all growth traits except birth weight. These estimates indicate that selection based on crossbred performance could be more effective than intra-population selection for growth traits. Genetic covariances between purebred and crossbred population were generally positive. However, negative genetic correlations were observed in the crosses involving Suffolk, Columbia and Targhee for birth weight.

B. Dairy Sheep (H. Sakul and W.J. Boylan)

The evaluation of milk production in 1987 was a continuation of the studies done in 1985 and 1986, with an increase of 28 ewes in the number of ewes on trial. A total of 108 ewes were milked for about 4 months including 6 Romanov ewes imported from Canada. The number of ewes and the experimental design were comparable to 1985 and 1986. A 4 breed diallel mating design and 3 other straightbred matings were the source of the data. Ewes were put on trial following weaning of their lambs at 30 days of age, and milk obtained was processed into a variety of experimental chesses. Least-squares means for milk traits are shown in Table 1.

Table 1. Least-squares means for milk traits (1987)

Category				Milk Composition (%)			
Purebreds	N	Total yld (liters)	Average Daily yld (ml)	Fat	Protein	Lactose	Total Solids
Dorset	6	52.8 ± 9.73	444.9 ± 73.86	7.2 ± .26	5.8 ± .14	4.5 ± .12	18.3 ± .35
Finn	6	74.8 ± 9.73	569.7 ± 73.86	6.2 ± .26	5.5 ± .14	4.6 ± .12	17.1 ± .35
Lincoln	6	60.9 ± 9.73	493.0 ± 73.86	6.4 ± .26	5.5 ± .14	4.8 ± .12	17.5 ± .35
Rambouillet	5	66.9 ± 10.66	560.5 ± 80.91	6.2 ± .28	5.9 ± .16	4.8 ± .13	17.8 ± .38
Romanov	5	32.3 ± 10.66	224.7 ± 80.91	6.8 ± .28	6.2 ± .16	4.6 ± .13	18.5 ± .38
Suffolk	6	90.0 ± 9.73	724.4 ± 73.86	6.5 ± .26	5.6 ± .14	4.8 ± .12	17.7 ± .35
Targhee	5	68.6 ± 10.66	588.4 ± 80.91	6.0 ± .28	5.5 ± .16	4.7 ± .13	16.9 ± .38
Crossbreds	69	72.6 ± 12.05	600.08 ± 91.46	6.2 ± .32	5.7 ± .18	4.7 ± .15	17.4 ± .43

C. Lamb Mortality (C. Yapi, W.J. Boylan and R.A. Robinson)

This study was deisgned to access factors of major importance on lamb mortality and its causes. The preliminary results concerning causes of death have been previously reported. Lambs involved in the study were born during 1981 to 1985, from pure breeds (Dorset, Finnsheep, Lincoln, Rambouillet, Suffolk and Targhee) and three synthetic lines developed from crossbred foundations: Syn I (Finn x Lincoln), Syn II (Dorset x Rambouillet) and Syn III (Finn x Lincoln x Dorset x Rambouillet.

Lamb mortality was divided into five components: (1) discrete scores, 1 to 4, classified according to the time of death (1 = alive at weaning, 2 = died before weaning, 3 = died during the birth process and 4 = died before birth); (2) the discrete scores were transformed onto the ordinate of the standard normal curve using the frequency for each score; (3) mortality at birth of total lambs born; (4) mortality at weaning of total lambs born and (5) mortality at weaning of live born lambs. The analysis of variance for the five components is summarized in table 2. The data indicate that year of birth, breed of lamb and lamb birth weight were significant sources of variation for lamb mortality. The effect due to breed is summarized in table 3. The Finnsheep and the Syn III (1/4 Finn) had the lowest mortality and were significantly different from the other breeds.

Table 2. Least-squares analyses of variance for mortality of lambs from the purebreds and synthetic lines.

Sources of variation	Degrees of freedom	Discrete score	Normalized Score	Mortality at birth (total born)	Mortality at weaning (total born)	(total born alive)
Year	4	1.73**	2.29**	0.15*	0.89*	0.79**
Breed	8	0.98**	1.26**	0.15**	0.67**	0.50**
Sex	1	2.33*	2.96*	0.14*	1.00*	0.63T
Age of dam	4	1.02*	0.99T	0.09	0.30	0.23
Type of birth	2	0.23	0.11	0.12	0.02	0.12
Birth weight	1	44.35**	40.96**	6.04**	13.47**	5.01**
Birth weight^2	1	22.78**	19.49**	3.66**	5.83**	1.93**
Weight of dam	1	0.11	0.27	0.02	0.39	0.54T
Residual (a)		0.38	0.45	0.06	0.17	0.15

Tp<.10
*p<.05
**<.01

(a) Degrees of freedom are 1914, 1914, 1914, 1914 and 1785 respective to the traits.

Table 3. Estimates of least-squares constants of breed effect on mortality of lambs from the pure breeds and synthetic lines.

	Discrete score	Normalized score	Mortality at birth (total born)	Mortality at weaning (total born)	Mortality at weaning (total born alive)
Overall mean	1.37	1.11	7.38%	29.28%	23.44%
Breeds	**	**	**	**	**
Suffolk	0.13 ± 0.06^{a}	0.15 ± 0.06^{a}	3.66 ± 2.14^{a}	8.59 ± 3.76^{a}	6.58 ± 3.70^{a}
Targhee	0.08 ± 0.05^{a}	0.08 ± 0.05^{a}	3.61 ± 1.82^{a}	3.07 ± 3.19^{ab}	0.86 ± 3.12^{ab}
Dorset	0.03 ± 0.04^{ab}	0.02 ± 0.05^{ab}	2.74 ± 1.67^{a}	1.44 ± 2.93^{ab}	-0.92 ± 2.90^{ab}
Lincoln	0.03 ± 0.05^{ab}	0.06 ± 0.06^{ab}	-3.25 ± 2.11^{ab}	6.73 ± 3.70^{a}	9.40 ± 3.53^{a}
Rambouillet	0.05 ± 0.05^{ab}	0.07 ± 0.06^{ab}	-0.00 ± 3.58^{a}	7.38 ± 3.58^{a}	7.66 ± 3.47^{a}
Finnsheep	-0.17 ± 0.05^{c}	-0.19 ± 0.51^{c}	-6.01 ± 1.79^{b}	-13.94 ± 3.14^{c}	-11.18 ± 3.14^{b}
Syn I	-0.05 ± 0.04^{abc}	-0.06 ± 0.04^{abc}	-1.11 ± 1.56^{ab}	-3.50 ± 2.73^{ab}	-2.84 ± 2.66^{ab}
Syn II	0.01 ± 0.05^{abc}	0.00 ± 0.06^{abc}	1.63 ± 1.98^{a}	-0.88 ± 3.47^{ab}	-1.64 ± 3.33^{ab}
Syn III	-0.11 ± 0.04^{bc}	-0.13 ± 0.05^{bc}	-1.25 ± 1.63^{ab}	-8.90 ± 2.86^{bc}	-7.92 ± 2.75^{b}

Means with different superscripts in the same column are different ($P<.05$).

D. Additive and Multiplicative Correction Factors of Economic Traits (M.P. Abdel-Aziz and W.J. Boylan)

Data collected from 1968 to 1987 are being used to determine the effect of some non-genetic factors on economic traits and to estimate additive and multiplicative correction factors specific for each trait in each breed studied.

The six breeds include Suffolk, Finn, Targhee, Dorset, Lincoln, and Rambouillet, in addition to three synthetic breeds. However, only preliminary analyses of variance of Suffolk performance data are presented in table 4. Additive and multiplicative correction factors, standard deviations are shown in table 5.

The validity of using additive or multiplicative correction factors are being asessed for each trait.

Table 4. Analyses of variance of several performance traits from Suffolk data.

s.v.	df	Birth wt (kg)	df	70 day wn wt (kg)	df	Final wt (kg)
Year	19	4.941**	19	174.544**	19	133.875**
Age of dam (A)	4	3.450**	4	139.305**	4	23.317
Sex (B)	1	17.807**	1	126.438**	1	380.705**
Type of birth or birth & rearing (C)	2	113.112**	5	634.536**	5	24.309
AB	4	.553	4	69.789*	4	15.508
AC	8	.572	8	15.511	8	20.115
BC	2	1.900*	2	22.371	2	13.327
Covariable +	1	28.881**	1	863.590**	1	87.872*
Error	763	.615	589	22.241	525	15.570
Total	804		633		569	
R^2 (%)	49		45		37	

+ Dam weight at breeding for birth weight or dam weight at weaning for 70 day weaning weight and final weight.

* $P<0.05$.

** $P<0.01$.

Table 5. Additive and Multiplicative correction factors and standard deviations and coefficient of variation of several performance traits from Suffolk data.

Class	Add.	Adjusted st. dev.	cv	Multi.	Adjusted st. dev.	cv
			Birth Weight			
Age of dam						
Year 1	.845	1.133	27.5	1.205	1.365	33.2
Year 2	.399	1.044	22.9	1.087	1.135	24.9
Year 3	.025	.944	19.1	1.005	.949	19.2
Year 4*	.000	1.112	22.4	1.000	1.112	22.4
Year 5+	.116	1.020	21.1	1.024	1.044	21.6
Sex						
Male*	.000	1.082	21.9	1.000	1.082	21.9
Female	.496	1.015	22.9	1.112	1.128	25.4
Type of birth						
Single*	.000	1.139	19.9	1.000	1.139	19.9
Twins	1.257	.915	20.5	1.282	1.173	26.3
Triplets+	1.857	.974	25.2	1.481	1.442	37.3
			70 Day Weaning Weight			
Age of dam						
Year 1	4.591	5.701	32.1	1.258	7.172	40.4
Year 2	5.474	5.760	34.1	1.324	7.626	45.1
Year 3	- .555	5.779	25.2	.976	5.640	24.6
Year 4*	.000	5.906	26.4	1.000	5.906	26.4
Year 5+	- .238	6.542	28.9	.990	6.477	28.7
Sex						
Male*	.000	6.556	29.9	1.000	6.556	29.9
Female	1.224	5.615	27.1	1.059	5.946	28.7
Type of birth & rearing						
s/s*	.000	6.094	23.8	1.000	6.094	23.8
tw/s	3.911	6.734	31.1	1.181	7.953	36.7
tw/tw	6.358	5.257	27.4	1.331	6.997	36.4
s,tw,tr/n	7.471	4.453	24.6	1.413	6.292	34.8
tr/s	3.231	5.398	24.2	1.145	6.181	27.7
tr/tw	4.626	5.872	28.0	1.221	7.170	34.2

*	adjustments based on these classes
s/s	single raised single
tw/s	twins raised single
tw/tw	twins raised twins
s,tw,tr/n	single, twins, or triplets raised nursette
tr/s	triplets raised single
tr/tw	triplets raised twins

E. The Relative Performance of Purebred Romanov and Romanov sired Lambs with Some Standard Breeds (W. Paszek, R.M. Jordan and W.J. Boylan)

During the Fall of 1987, 81 crossbred lambs represented by Dorset, Finn, Romanov, Suffolk and Targhee sired lamb were group fed in replicate to assess the comparative performance of Romanov sired lambs with standard breeds. The lambs were produced in August and September by Finn, Mouflon x Suffolk, Finn x Lincoln, Mouflon x Finn, Finn x Lincoln x Dorset x Rambouillet, and Dorset x Rambouillet ewes. The Mouflon crosses produced the bulk of the lambs without hormone therapy.

Significant differences in ADG by lambs sired among the various breeds were detected.

Cumulative ADG (Least-Squares Means)

Dorset	-	313.2[a] grams
Targhee	-	306.5[a] grams
Suffolk	-	292.4[b] grams
Finn	-	266.8[b] grams
Romanov	-	262.5[b] grams

ab ($P<.01$)

No significant differences in feed efficiency of lambs by breed of sire were found

		kg of feed/kg of gain (Least-Squares Means)
Suffolk	-	3.210
Targhee	-	3.333
Dorset	-	3.433
Finn	-	3.624
Romanov	-	3.660

No significant differences in ADG by breed of dam were detected.

Breed of dams	ADG (Least-Sqaures Means)
Finn	298.8 grams
Mouflon x Suffolk	298.1 grams
Finn x Lincoln	294.7 grams
Finn x Lincoln x Dorset x Rambouillet	275.6 grams
Mouflon x Finn	269.5 grams
Dorset x Rambouillet	265.5 grams

This experiment is being continued with 144 spring born lambs (14 replicated pens) fed in a similar manner. Breeds and crosses compared are: Purebred Finn, purebred Romanov, crosses: Romanov x Finn, Romanov x Dorset, Finn x Lincoln, Dorset x Rambouillet, Finn x Dorset x Lincoln x Rambouillet.

II. Objectives 2 and 3 of NC-III

NC-III project encompasses Minnesota's project entitled "Nutrition of Sheep Under Intensive Production".

A. Nutrition and Management of Growing Lambs (R.M. Jordan, H.E. Hanke and R.J. Vatthauer)

A 2 x 2 x 2 x 3 factorial designed experiment was conducted to access the effects of: a) extended hours of light; b) corn silage or alfalfa hay as a roughage source; c) Ivermectin treatment and d) soybean meal, a 2:1 soybean meal and blood meal mixture, and corn gluten meal as sources of supplemental protein, on the performance of finishing lambs.

Supplemental light did not increase ADG, feed intake or feed efficiency and decreased margin over feed costs per lamb. Lambs treated with Ivermectin tended to gain faster ($P>.10$), ate the same amount of feed as untreated lambs and had a greater margin over feed costs. Lambs fed alfalfa hay gained faster ($P>.10$), consumed more TDN daily, required slightly less TDN/unit of gain and had a larger margin over feed costs than lambs fed corn silage. The performance of lambs supplemented with SBM or 2:1 SBM and blood meal were similar and both treatments produced significantly ($P>.10$) faster ADG, greater TDN intake daily and had greater margin per lamb over feed costs than lambs supplemented with corn gluten meal. The advantage of by-pass protein as provided by either blood meal or corn gluton meal were not evident in these comparisons.

A 2 x 2 x 3 factorial experiment to determine the effects of Ivermectin treatment, the addition of 3% stabilized animal fat and three levels of SBM to the diet, involving a total of 51 lambs per treatment, was conducted. Performance of lambs treated with Ivermectin was virtually identical in all aspects to untreated lambs. Lambs fed diets supplemented with 3% animal fat had ADG, daily feed intakes, and feed efficiency similar to lambs that received no supplemental fat. Levels of protein significantly ($P<.10$) influenced lamb performance. Diets containing 5% added SBM resulted in slower ADG and lower feed efficiency than diets containing 16% added SBM. Intake of protein was about 25% greater when 16% SBM diets were fed. The performance of lambs fed diets containing 10% added SBM was not different from lambs fed 16% SBM.

B. Creep Diets (R.M. Jordan and H.E. Hanke)

The relative efficacy of a commercial (proprietary) ground lamb creep diet was compared with a relatively simple "home-mixed" ground creep diet. Both diets contained 10 to 20% protein, antibiotics and a coccidiost. The commercial diet cost about 2.5 times the home-mixed diet. Treatments were replicated four times. Lambs fed the commercial diet ate significantly more feed daily but ADG was not different (.36 kg vs. 34 kg for commercial

and home-mixed diets, respectively). Lambs fed the commercial diet were less efficient than lambs fed the home-mixed diet. Post-weaning, lambs fed the commercial diet gained .50 kg daily and lambs fed a home-mixed grower diet gained .47 kg daily.

Feed costs per unit of gain for the home-mixed diet were about 35% of the cost of the commercial diet during the creep feeding period and 75% during the post-weaning period.

C. Grazing Studies (R.M. Jordan and Gordon C. Marten)

Pastured alfalfa, birdsfoot trefoil, red clover and cicer milkvetch were compared during a 3 year period for the following characteristics: palatability, percent leaves, pre and post-grazing, crude protein, IVDDM, lamb grazing days per hectare, lamb gains per hectare and ADG.

Alfalfa and red clover were equal in palatability and both were significantly (P<.10) more palatable than birdsfood trefoil and birdsfoot trefoil was more palatable (P<.10) than cicer milkvetch. On average red clover had significantly more leaves both pre and post-grazing and alfalfa the least (P<.10). Percent leaves pre and post-grazing on birdsfoot trefoil and cicer milk vetch were not different. However the percent crude protein in the leaves, stem and entire plant were highest in alfalfa (P<.10) and lowest in the entire plant of cicer milkvetch.

The IVDDM of the leaves of cicer milkvetch was significantly (P<.10) less than of alfalfa but not of birdsfoot trefoil or cicer milkvetch. Conversely red clover had the highest IVDDM of stems and of the entire plant (P<.10).

Lamb carrying capacity varied among years and species. Cicer milkvetch had the lowest carrying capacity the first year but during the second and third years the greatest. Over the three year period birdsfoot trefoil averaged the lowest carrying capacity. During the third year, red clover had significantly (P<.10) lower carrying capacity due to lack of stand persistance and sensitivity to dry weather. Despite cicer milkvetch's lower nutrient content, its advantage in yield resulted in the greatest pounds of lamb production per hectare (P>.10). Lamb production for the other three forages were similar. The ADG among the four forage species during the three year period ranged from .22 kg (alfalfa) to .23 kg (birdsfoot trefoil) and were not different among treatments (P>.10).

About 15 percent of lambs grazing cicer milkvetch were affected by photosensitization and had to be removed from the trial.

D. Gestating and Lactating Ewe Diets (R.M. Jordan and H.E. Hanke)

Ninety-five gestating Columbia ewes weighing 96 kg were fed corn silage supplemented with corn alfalfa hay and levels of SBM or blood meal to provide isocaloric levels of energy and 98%, 106%, 121% of NRC suggested protein levels, when supplemented with SBM,

or 106% when supplemented with blood meal. Weight changes among treatments were similar (12.7 kg to 13.5 kg). Fleece weight varied from 6.0 kg to 6.1 kg and lamb birth weight from 5.0 kg to 5.6 kg (P>.10). Lamb weights at 40 day ranged from 13.3 to 14.6 kg (P>.10).

During lactation ewes that had been fed the low, medium and high SBM levels during gestation were fed a 4:1 alfalfa-straw diet supplemented with corn and SBM to provide isocaloric intakes of energy and .39, .42 and .48 kg protein per ewe daily. These levels are about 92%, 100% and 114% of NRC suggested levels. Ewe previously supplemented with fish meal were fed similarly, plus fishmeal to provide .42 kg protein in the diet. Protein intake had no effect on either ewe or lamb weight changes (P>.10).

Lactating ewes suckling 1.7 lambs per ewe were fed for 56 d either: a) 45:55 corn-hay diet; b) 25:75 corn-hay diet or c) 20:75 corn-hay diet plus 5% animal fat. TDN intake per unit of body weight was similar among treatment though protein intake was about 20% greater in diets containing the high hay intakes.

Weight changes of the ewes were significantly P<.05 affected by treatment with ewes fed the fat fortified diet losing the least weight. However lamb ADG were .43, .41 and .36 kg for the 45% corn, 25% corn and the added fat diet, respectively (P<.05). Creep intake by lambs suckling ewes fed the fat fortified diet was .25 kg daily compared to .38 amd 44 kg daily by lambs suckling ewes fed 45% corn or 25% corn, respectively.

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OBJECTIVE II. DEVELOP FEEDING STRATEGIES FOR HIGH PRODUCING SHEEP

A Nutrition and Management for Efficient Lamb Production (Previous Title - Crookston, MN)

H.F. Windels and R.M. Jordan

A three-year study was completed in 1987 to determine the effect of grinding barley and corn on lamb performance when fed in combination with alfalfa haylage in an ad libitum-fed total mixed ration (70% grain, 30% forage on a DM basis). The study involved 732 February-born, early weaned (8 weeks), sheared, primarily Suffolk-cross, intact ram lambs [3 pens (20 or 21 head/pen)/treatment-/year]. A three-year summary of performance data is presented in Table 1. Grinding did not significantly ($P<.05$) influence the utilization of barley or corn when fed with alfalfa haylage in a total mixed ration. Corn promoted 10.3% more efficient ($P<.01$) and 6.8% faster ($P<.01$) lamb gains than did barley.

Table 1. Performance of Lambs Fed Ground vs Whole Corn or Barley With Haylage.

Item	Ground Corn	Whole Corn	Ground Barley	Whole Barley
No. Head	183	183	183	183
Init. Wt., lb	62.9	63.5	63.3	63.6
Final Wt., lb	125.3	125.0	123.6	123.0
Avg. Daily Gain[a]	.91	.89	.84	.84
Avg. Daily Feed D, lb[b]	3.81	3.66	3.81	3.90
Feed DM/100 lb Gain, lb[c]	420	411	453	464

[a] Corn significantly greater ($P<.01$).
[b] Corn significantly less ($P<.01$).
[c] Corn significantly more efficient ($P<.01$).

B. Factors Affecting Performance of Highly Productive Sheep (New Project Title - Crookston)

H.F. Windels and R.M. Jordan

The objectives of the new project are: 1) to determine more precisely the energy requirement of highly productive sheep during the maintenance stage of production (weaning to prebreeding) for optimum reproductive and lactation performance in a northern climate, 2) to determine more precisely the energy requirement of lactating ewes rearing twins and triplets, and 3) to determine the effect of tail docking, shearing and sex of lamb on the incidence of rectal prolapses in feedlot lambs.

Objective 1. In this study 160 Polypay ewes (initial age 1½ years) will be randomly assigned to four levels of digestible energy per 100 lb of body weight based on 80, 95, 110, 125% of the National Research Council minimum requirements for digestible energy. The length of the study will be three years, ewes will be maintained in drylot the year around and ewes will continue on the same treatment for the duration of the trial. NRC minimum requirements for digestible energy will be used for all other stages of production and for all other nutrients. Ewes will be sheared in January, lamb indoors in February and moved to outside lots with shelters when lambs are 7 days old. Alfalfa haylage will be the forage.

Objective 2. This study will utilize 1/4 Finn, 1/2 Suffolk, 1/4 Targhee ewes (about 40/year) rearing twins or triplets fed four digestible energy intake levels based on 90, 100, 110 and 120% of NRC minimum digestible energy requirements for ewes nursing twins. Ewes will be individually penned and fed alfalfa haylage and corn (50:50) on a dry matter basis for six weeks. Milk yield will be determined by the suckle-weigh-suckle-weigh method weekly for six weeks beginning at one week post-lambing.

Objective 3. The experimental design of the rectal prolapse study (2 years) will be a randomized complete block with a 2 x 2 x 2 factorial arrangment of treatments. The factors will be tail length, sex, and shearing. Tail length will be about 1/2 inch vs 3 inches and shearing will be at 2 1/2 months of age. Lambs will be home-raised, creep fed, early weaned (8 weeks) and of 3/4 Suffolk breeding. The feedlot diet will be 20% alfalfa haylage and 80% grain on a DM basis, complete mixed and fed once daily to appetite. Lambs will be marketed at slaughter weights of 110-120 lbs for females and 120-130 lbs for males. The first trial is in progress with 256 lambs.

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

1987 Station report to NC-111

K.A. RINGWALL

I. Objective 1 of NC-111: Increase the efficiency of reproduction and growth of sheep.

A: Evaluate ewe production and offspring performance of specific crosses of Booroola Merino, Finnish Landrace and Rambouillet breeds of sheep under different management systems.

K.A. Ringwall and T.C. Faller

The reproductive performance, wool production, and longevity are being evaluated for F1 Booroola Merino x Rambouillet, F1 Finnish Landrace x Rambouillet and Rambouillet (control) ewes under confinement versus semi-range management. Crosses to obtain these ewes were made in 1984 and 1985 utilizing a group of Wyoming Rambouillet range ewes and Finn or Booroola Merino rams leased from USDA-Roman L. Hruska U.S. Meat Animal Research Center, Clay Center, Nebraska. The Rambouillet control ewes were purchased from the same source as the ewes utilized in making the F1 crosses. In the falls of 1986 and 1987, a minimum of 36 Booroola cross, 36 Finn cross, and 36 control ewes were randomly selected from those lambs born during 1985 and 1986. All ewes and lambs are fed by current NRC requirements for sheep.

Ewes born were further sub-divided randomly, following lambing as two year old ewes, between drylot and pasture groups. Thirty ewes of each breed type were placed in drylot prior to lambing until November breeding. Their lambs are raised under total confinement. An additional 30 ewes were assigned to a pasture system with the lambs raised on pasture. Both groups of ewes are combined from breeding to just prior to lambing and allowed to stubble graze until winter and then fed under drylot. Rambouillet rams have been used during the 35 day breeding seasons starting in early November.

RESULTS AND DISCUSSION. Weaning weights and early growth data are not available on all breed groups since the Rambouillet control ewe lambs were were born and raised under range conditions, while the crossbred ewe lambs were raised under drylot conditions. Differences between the two rearing systems are assumed to be nonsignificant as the ewes start the first year of the trial at eighteen months of age.

Table 1 presents the completed early growth data concerning the three types of sheep involved. The Finn ewe is the largest at all ages. Throughout summer grazing, the Rambouillet ewes gained more weight than either the Booroola or Finn. Prior to breeding at 20 months of age, the Finn is still the heaviest ewe, followed by the Rambouillet and the Booroola is the lightest.

The April reproductive performance and subsequent lamb growth is presented in Table 2. These data only include the first years performance of those ewes born during 1985. The ewes were split into drylot and pasture groups following the 1987 weaning. Currently, both the Booroola and Finn cross ewes have greater fertility and prolificacy than the Rambouillet. Although the Booroola and Finn appear similiar, previous work has suggested that not all the sires that produced the Booroola crossbred ewes were homozygous for the Booroola fertility gene and that one of the sires did not carry the gene at all. Therefore, the Booroola performance would be expected to be lower than anticipated if all the ewes carried the Booroola fertility gene. Growth rate appears to be lower for the Booroola cross than the Finn cross or Rambouillet ewes, but greater in wool production.

B: Determine the effect of season on scrotal circumference of Rambouillet rams and reproductive characteristics of their offspring.

K.A. Ringwall, T.C. Faller and J.E. Tilton

The influence of season on scrotal circumference of Rambouillet rams and reproductive characteristics of their offspring are being evaluated. Rambouillet rams are evaluated yearly and classified as seasonal or nonseasonal rams. Seasonal rams are defined as those rams whose scrotal circumferences decrease dramatically from fall to spring while non-seasonal rams show no seasonal trend to change in scrotal circumferences. Scrotal measurements are obtained in late February and late July from the Glenn Brown flock, Buffalo, SD and ram selection is based on these two measurements. Seven seasonal rams and five nonseasonal rams have been purchased and evaluated monthly at the Research Extension Center. Nonseasonal rams are much harder to find within the Brown flock than seasonal rams. Blood sampling for later analysis for luteinizing hormone was started in October 1987 and done monthly. The rams are bled at -30, 0, 15, 60 and 75 minute intervals with 1 Ug GnRH administered at 1 and 61 minute time periods.

Currently, 25 to 30 Rambouillet ewes per ram are mated yearly to four seasonal and four nonseasonal rams to produce progeny. Seasonal and nonseasonal daughters are being compared at 10 months of age for ovulation rate and 14 to 18 months of age for the ability to conceive at the beginning or end of the breeding season. The ewes will be evaluated as dry ewes exposed to rams during August and April; and as wet ewes (recently weaned) during April and November. An upgrading breeding program will be practiced by continually breeding seasonal sired ewes to seasonal rams and nonseasonal sired ewes to nonseasonal rams. Each generation of progeny will be re-evaluated as described above.

RESULTS AND DISCUSSION. Four Rambouillet rams were purchased in August of 1985, 1986 and 1987 after initial evaluation of Brown's Rambouillet rams. In 1985 two rams were selected each from two different age groups of rams, while in 1986 and 1987 all four rams were from the same age group. These rams have had scrotal circumference measurements taken on a monthly bases since arriving at the station. Based on the March to pre-breeding measurements (the scrotal circumferences used to select the rams) living rams 4066, 6014 and 6559 were classified as nonseasonal and rams 4162, 5303, 5367, T311, 7242 and 6579 were classified as seasonal.

The accuracy of classification based on two measurements appears to be repeatable (Table 3). The first eight rams that were purchased have had the March through pre-breeding measurements retaken and the scrotal circumference changes the following year were similar with the exception of 5367. Those rams purchased in 1987 do not have one full years measurements available.

The mating and lambing performance of ewes exposed to each ram is presented in Table 4. The ability of seasonal or nonseasonal rams to mate and conceive lambs during the fall appears to be similar, however there is a slight advantage for the seasonal rams. The difference between the number of ewes mated during the first cycle from 1985 versus 1986 and 1987 is accounted for by the change in breeding times. Seasonal daughters had greater reproductive performance in terms of pregnant ewes than did nonseasonal daughters during August breeding, although ram 6135 (settle 1 ewe out of 26) was exposed to nonseasonal daughters.

Ewe lambs sired by seasonal and nonseasonal rams purchased in 1985 and 1986 were evaluated for puberty and ovualtion rate during the fall of 1987. In Table 5, 15 of 24 (62.5%) seasonal ewe lambs were cycling by December 12, 1987 and 15 of 28 (53.6%) nonseasonal ewe lambs were cycling. These results are similar to those in 1986, (seasonal = 72.2% versus nonseasonal = 69.2% cycling). Updated ovulation rates are presented Table 5, and were 1.22 CL for ewe lambs sired by seasonal rams and 1.25 CL for ewe lambs sired by nonseasonal rams. Daughters of ram 5367 were omitted from these numbers because of his mixed classification. The number of daughters of each seasonal or nonseasonal ram that mated during June, July or August as long yearlings is indicated in Table 4. There are no obvious differences between daughters of seasonal rams or nonseasonal daughters in the ability to express estrus during the summer at this point in the trial.

C: Evaluate the genetic mechanism which determines increased prolificacy of Booroola Merino ewes and develop breeding schemes to introduce Booroola fertility into North Dakota fine wool flocks.

K.A. Ringwall and T.C. Faller

A flock of 80 F1 Rambouillet X Booroola Merino ewes are maintained under semi-range conditions at the NDSU Research Extension Center - Hettinger. These ewes were obtained as described under section (A.) Starting in august of 1988, these ewes will be mated to Rambouillet rams, and those daughters (3/4 or greater Rambouillet) that have multiple ovulations at 10 months of age will be selected to remain in the flock. Single and none ovulating ewes will be culled. A control flock of Rambouillet ewes (from the same source as the original Rambouillet ewes used to produce the F1 Rambouillet X Booroola Merinos) is being maintained and bred to Rambouillet rams.

The same F1 Rambouillet X Booroola Merino ewes as described above were mated to Booroola Merino rams in 1986 and 1987. Starting in august of 1988 the daughters of these matings that had multiple ovulation rates at 10 months of age will be mated to F1 Rambouillet X Booroola Merino rams and selection for multiple ovulation rate will continue as previouly described.

RESULTS AND DISCUSSION. Table 6 indicates the production characteristics of Rambouillet ewes bred to F1 Rambouillet X Booroola Merino rams, F1 Rambouillet X Booroola Merino ewes bred to Booroola Merino rams and Rambouillet ewes bred to Rambouillet rams. Reproductive performance is greater for the F1 RXBM ewe than the Rambouillet ewe, however the Rambouillet ewe appears to wean a heavier lamb. Growth rate is a trait that needs to be improved in the Booroola Merino. The Rambouillet ewes in Table 6 are all aged ewes. Although not presented in the table, the F1 Rambouillet X Booroola Merino ewes averaged 12.1 lbs of wool which yielded 55.26%, contained 2.03% vegetable matter and had a fiber diameter of 24.03 microns (60's) with a standard deviation of 5.95 microns. The Rambouillet ewes sheared 13.0 lbs of wool which yielded 58.44%, contained 1.21% vegetable matter and had a fiber diameter of 23.28 microns (62's) with a standard deviation of 4.56 microns. The wool data is from Rambouillet ewes that were born in 1986 and represent the second generation of control ewes, but will not lamb until winter 1988.

The results of the laparoscopies have been presented in Tables 5 and 7 in terms of ovulation rates detected from ewe lambs of each sire. After three years data, not all the purebred Booroola rams leased from MARC at Clay Center, Nebraska would appear to be homozygous for the Booroola fertility gene. The data presented in Table 7 would suggest that ram 1 was a non-carrier of the gene, ram 2 was heterozygous, and rams 3 - 11 were homozygous

Nine groups of progeny test ewes were mated to F1 Rambouillet X Booroola Merino rams during the fall of 1986. The progeny from these matings were evaluated during December of 1987 (Table 7). With the exception of ram 5, all the F1 Rambouillet X Booroola Merino rams progeny had greater ovulation rates than did the control Rambouillet ewelambs (Table 5). Overall, Rambouillet ewes produced 1.26 Corpra Lutea, F1 Rambouillet X Booroola Merino ewes produced 1.97, backcrossed 3/4 Rambouillet 1/4 Booroola Merino ewes produced 1.77 and backcrossed 1/4 Rambouillet 3/4 Booroola Merino ewes produced 2.43.

II. Develop feeding strategies for high-producing sheep.

A: Comparisons of lambs fed barley or corn diets fed in whole or ground form.

D.O. Erickson, T.C. Faller, K.A. Ringwall
W.D. Slanger and P.T. Berg

Two experiments, utilizing 640 early weaned lambs, were conducted to determine the comparable feeding values of barley to corn each fed in whole and ground form. Complete mixed diets containing 16% protein and 26% alfalfa were self fed. Soybean meal was the protein supplement. Lambs averaged about 60 pounds across lots at the start of the experiment and were taken off near 100 pounds. Final weights were similar (P>.05) across dietary treatments. Lambs consumed more (P<.01) of the corn diets (3.10 lb/d) compared to those on the barley diets (2.86 lb/d). Gains and feed efficiencies were similar (P>.05) between grains and physical forms. Quality grade was slightly higher, 11.4 vs 11.1 for corn and barley respectively (P<.06). The % kidney was higher (P<.01) for the lambs on corn, indicating more mesentery fat. However, backfat was similar (P>.05) between corn and barley but was higher (P<.002) (.20 vs .18) for whole grains and ground grains respectively. The corn diets required 15% soybean meal and the barley diets 10% which represents a considerable savings in protein supplementation of the barley diets. The feed needed for unit of gain was the same for both diets. These data support that of previously reported experiments comparing barley to corn for lambs. It also supports the 1987 experiments conducted at the main station in Fargo.

B: Performance and carcass characteristics of lambs fed corn or barley supplemented with soybean meal or distillers dried grains.

D.O. Erickson, M.J. Marchello, P.T. Berg, J.T. Schmidt,
W.D. Slanger and B.L. Moore

Barley was compared to corn supplemented with either soybean meal (SBM) or distillers dried grains (DG) in complete ground mixed lamb diets. Three experiments were conducted utilizing early weaned lambs. The diets were iso-nitrogenou (14% protein) and iso-caloric (72% TDN). Lambs on the barley diets consumed an average of 3.57 pounds per day compared to 4.07 on the corn diets (P<.0003) which resulted in lower (P<.0003) daily gains (.76 and .87 respectively). The lambs on the barley diets were equally (P>.05) as efficient to corn in feed utilization. Lambs on the corn diets required more (P<.05) feed/gain when supplemented with DG and there was no difference in efficiency due to protein source when barley was fed. The average final weight for the corn fed lambs was 107 pounds compared to 101 pounds (P<.009) for those on barley. This may have contributed to the slightly higher (P<.003) dressing % 54 and 52% respectively for corn and barley and a slightly higher (P<.03) loin weights of 2.88 and 2.57 kg respectively for corn and barley. There were no significant differences due to diet (either grains, protein sources or interactions) among all the other carcass criterion (back fat, kidney %, loin area, conformation grade, leg score and yield grade).

TABLE 1

BODY WEIGHT (LBS) OF F1 BOOROOLA X RAMBOUILLET, F1 FINN X RAMBOUILLET AND RAMBOUILLET EWES LAMBS BORN DURING 1985 AND 1986

	INITIAL EWE LAMB NUMBERS	SEVEN MONTH WEIGHT	YEARLING WEIGHT	PRE-BREEDING WEIGHT
	(1985)			
RAMBOUILLET	35		103	125
BOOROOLA X	36	91	121	119
FINN X	36	109	141	137
	(1986)			
RAMBOUILLET	40		100	132
BOOROOLA X	57	80	106	124
FINN X	36	102	132	147

TABLE 2

APRIL REPRODUCTIVE PERFORMANCE AND SUBSEQUENT LAMB GROWTH OF BOOROOLA MERINO X RAMBOUILLET, FINNISH LANDRACE X RAMBOUILLET AND RAMBOUILLET X RAMBOUILLET EWES BORN DURING 1985

	EWE TYPE		
	BOOROOLA MERINO	FINNISH LANDRACE	RAMBOUILLET
NUMBER OF EWES EXPOSED	39	36	37
NUMBER OF EWES LAMBING	34 (87%)	32 (89%)	29 (78%)
NUMBER OF LAMBS BORN	71 (209%)	75 (234%)	34 (117%)
NUMBER OF LAMBS WEANED	50 (147%)	49 (153%)	26 (90%)
AVERAGE 56 DAY WEIGHT	30 lbs	36 lbs	37 lbs
SEPTEMBER 6 WEIGHT	63 lbs	81 lbs	82 lbs
DECEMBER 8 WEIGHT	91 lbs	112 lbs	108 lbs
1987 PRE-BREEDING WEIGHT	127 lbs	151 lbs	140 lbs
1987 FLEECE WEIGHT (19% moisture)	18.0 lbs	14.4 lbs	15.4 lbs

TABLE 3

SCROTAL CIRCUMFERENCE CHANGE FROM MARCH TO PRE-BREEDING FOR SEASONAL AND NONSEASONAL RAMS DURING THE FIRST AND SECOND YEAR OF EVALUATION

RAM NUMBER	CLASSIFICATION 1ST YEAR	/2ND YEAR	AVERAGE CHANGE (CM) 1985	1986	1987	ACROSS YEARS
2532	nonseasonal	/nonseasonal	2.9	2.1	dead	2.5
4066	nonseasonal	/nonseasonal	2.5	3.9	2.1	2.8
6014	nonseasonal	/nonseasonal		1.3	dead	1.3
6135	nonseasonal	/nonseasonal		0.6	3.7	2.2
6559	nonseasonal	/pending			2.5	2.5
5367	seasonal	/nonseasonal		8.2	2.7	5.4
3289	seasonal	/seasonal	8.7	8.7	dead	8.7
4162	seasonal	/seasonal	5.5	6.5	3.5	5.2
5303	seasonal	/seasonal		8.4	7.1	7.7
T311	seasonal	/pending			6.3	6.3
6579	seasonal	/pending			7.8	7.8
7242	seasonal	/pending			9.2	9.2

TABLE 4

NUMBER OF EWES MATED, EWES LAMBING AND SUBSEQUENT REPRODUCTIVE PERFORMANCE OF FEMALE OFFSPRING FOR NONSEASONAL AND SEASONAL RAMBOUILLET RAMS DURING FALL BREEDING WHEN EXPOSED FOR TWO ESTRUS CYCLES.

				Number Mated				Daughters Performance				
Ram	Class	Year	Ewes	1st Cycle	2nd Cycle	Total Mated	Ewes Lambing	Total Ewes	Total Mated June	July	Aug	Total Preg.
2532	N/N	1985	27	20	6	26	14	10	0	2	6	5
		1986	12	0	12	12	10					
4066	N/N	1985	27	24	3	27	22	8	1	4	7	0
		1986	12	0	12	12	10					
		1987	28	0	24	24	?					
6014	N/?	1986	12	1	11	12	11					
6135	N/N	1986	12	2	10	12	11					
		1987	28	12	15	27	?					
6559	N/?	1987	25	6	16	22	?					
5367	S/N	1986	12	1	11	12	11					
		1987	28	12	16	28	?					
3289	S/S	1985	26	23	3	26	22	14	1	3	12	12
		1986	12	1	11	12	10					
4162	S/S	1985	27	24	3	27	22	15	2	9	15	11
		1986	12	3	9	12	11					
5303	S/S	1986	12	4	8	12	10					
		1987	28	13	13	26	?					
6579	S/?	1987	25	12	11	23	?					
7242	S/?	1987	25	4	19	23	?					
T311	S/?	1987	24	19	5	24	?					

TABLE 5

NUMBER OF EWE LAMBS WITH NONE, SINGLE, TWIN, TRIPLET, QUADRUPLET OR QUINTRUPLET OVUATION RATES FOR RAMBOUILLET SIRES

OVULATION RATE	RAMBOUILLET SIRES 1	2	3	4	5	6	7	8
NONE	5	2	4	9	4	2	1	1
SINGLE	10	12	9	5	8	5	4	3
TWIN	4	5	2	1	0	3	3	2
TRIPLET	0	0	0	0	0	0	0	0
QUADRUPLET	0	0	0	0	0	0	0	0
QUINTRUPLET	0	0	0	0	0	0	0	0
TOTAL EWE LAMBS	19	19	15	15	12	10	8	6
AVERAGE CORPUS LUTEUM	1.29	1.29	1.18	1.17	1.00	1.38	1.43	1.40

SIRE 1: 4162, SIRE 2: 3289, SIRE 3: 4066, SIRE 4: 2532, SIRE 5: 5303, SIRE 6: 5367, SIRE 7: 6014, SIRE 8: 6135,

TABLE 6

JANUARY REPRODUCTIVE PERFORMANCE AND SUBSEQUENT LAMB GROWTH OF BOOROOLA MERINO X (F1 RAMBOUILLET X BOOROOLA MERINO), (F1 RAMBOUILLET X BOOROOLA MERINO) X RAMBOUILLET, AND RAMBOUILLET

EWE TYPE	RAMBOUILLET	F1 RXBM	RAMBOUILLET
RAM TYPE MATED TO	F1 RXBM	BOOROOLA MERINO	RAMBOUILLET
NUMBER OF EWES EXPOSED	107	39	96
NUMBER OF EWES LAMBING	83 (78%)	38 (97%)	81 (84%)
NUMBER OF LAMBS BORN	138 (166%)	81 (213%)	145 (179%)
NUMBER OF LAMBS WEANED	99 (119%)	53 (139%)	98 (121%)
AVERAGE 56 DAY WEIGHT	38 lbs	27 lbs	39 lbs
SEPTEMBER 6 WEIGHT	102 lbs	81 lbs	107 lbs
DECEMBER 8 WEIGHT	117 lbs	93 lbs	123 lbs
1987 PRE-BREEDING WEIGHT		127 lbs	149 lbs

TABLE 7

NUMBER OF EWE LAMBS WITH NONE, SINGLE, TWIN, TRIPLET, QUADRUPLET OR QUINTRUPLET OVUATION RATES FOR F1 RAMBOUILLET X BOOROOLA MERINO AND BOOROOLA MERINO SIRES

OVULATION RATE	F1 RAMBOUILLET X BOOROOLA MERINO								
	1	2	3	4	5	6	7	8	9
NONE	7	2	7	0	0	2	2	0	4
SINGLE	2	6	0	1	6	1	1	4	3
TWIN	2	2	5	3	0	3	3	2	5
TRIPLET	2	2	0	0	0	1	2	1	1
QUADRUPLET	0	0	0	0	0	0	0	1	0
QUINTRUPLET	0	0	0	0	0	0	0	0	0
TOTAL EWE LAMBS	13	12	12	4	6	7	8	8	13
AVERAGE CORPUS LUTEUM	2.00	1.60	2.00	1.75	1.00	2.00	2.16	1.88	1.77

SIRE 1: r356-569, SIRE 2: r449-425, SIRE 3: r663-722, SIRE 4: 85-1026, SIRE 5: 85-898, SIRE 6: 85-870, SIRE 7: 85-817, SIRE 8: 85-755, SIRE 9: 85-739

OVULATION RATE	BOOROOLA MERINO SIRES										
	1	2	3	4	5	6	7	8	9	10	11
NONE	3	1	2	0	2	2	0	5	3	2	2
SINGLE	10	6	2	4	2	3	1	3	1	2	1
TWIN	1	1	5	10	3	3	4	6	11	10	1
TRIPLET	0	0	0	0	1	1	1	3	3	4	1
QUADRUPLET	0	0	0	1	0	0	0	1	0	3	1
QUINTRUPLET	0	0	0	0	0	1	0	0	0	0	0
TOTAL EWE LAMBS	14	8	9	15	8	10	6	17	18	21	6
AVERAGE CORPUS LUTEUM	1.09	1.14	1.71	1.87	1.83	2.13	2.00	2.00	2.13	2.42	2.50
LAMBS BORN/ EWE LAMBING	1.33	1.96	2.25	2.11	2.50						

SIRE 1: 115-001, SIRE 2: 215-2002, SIRE 3: 015-001, SIRE 4: 215-001 SIRE 5: 015-002, SIRE 6: 315-013, SIRE 7: 315-002, SIRE 8: 315-016, SIRE 9: 315-025, SIRE 10: 83-1501, SIRE 11: 85-1500

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The Ohio State University
Ohio Agricultural Research and Development Center
1988 Annual Report to NC-111

I. Objective 1 of NC-111: Increase prolificacy and embryonic survival and reduce seasonality in sheep.

A. Factors affecting embryo manipulation and migration in sheep.

Experiment 1

Factors Affecting Embryo Migration in Sheep. K. P. Nephew, S. Xie, D. M. Broermann, J. O. Jones and W. F. Pope

Twenty-five mature ewes, having estrous cycles of normal duration, were utilized to determine if embryonic elongation and synthesis of embryonic estrogen (E_2) were related to intrauterine migration. Ewes were hemiovariectomized at least 60 days before the breeding season to allow for subsequent examination of intrauterine migration. On d 11-15 (n=5, d 0 = mating) embryos were recovered by flushing each uterine horn. Only multiovulating ewes were utilized, and intrauterine migration was considered to have occurred if an embryo(s) was recovered from the contralateral horn. Migration was coded (0= no migration; 1= migration) for subsequent analysis. De novo synthesis of E_2 was determined after a 6 h incubation by use of radioimmunoassay procedures. The occurrence of intrauterine migration was correlated with both embryonic length ($r=.83$; $P<.01$) and with in vitro E_2 synthesis ($r=.77$; $P<.01$). Embryonic length was also correlated ($r=.97$; $P<.01$) with E_2 synthesis. These data suggested that intrauterine migration occurred as ovine embryos elongated and began to synthesize estradiol.

Table 1. Intrauterine migration, embryo elongation and estradiol synthesis in ewes.

	Days post mating				
Item	11	12	13	14	15
Embryo migration[a]	0/5	0/5	0/5	3/5	5/5
Embryonic estrogen (pg)	18	57	6	170	232
Embryo length (cm)	.1	.1	.21	4.8	7.7

[a] No. of ewes experiencing migration/no. of ewes flushed.

Experiment 2

The Effect of Local Versus Systemic Progresterone Exposure and Initial Uterine Location on Embryonic Migration in Sheep. K. P. Nephew, D. M. Broermann, S. Xie, J. O. Jones and W. F. Pope.

Twenty crossbred ewes were utilized in two experiments to investigate the influence of local versus systemic exposure of progesterone and the initial location of concepti on embryonic migration. The first experiment utilized 10 ewes hemiovariectomized three months before ram exposure. Group I ewes (n=5) had corpora lutea removed on d 4 (d 0= estrus) and pregnancy maintained with exogenous progesterone. Ewes in group II (n=5) were subjected to a sham surgery and injected daily with vehicle (corn oil). Reproductive tracts were collected on d 15. The presence of embryos within both horns was indicative of embryonic migration. In the second experiment, ewes (n=5) were subjected to surgical attachment of the fimbria of one oviduct to the opposite mesovarium of the ovary remaining after hemiovariectomy. To ensure entry of ovulated oocytes into the contralateral uterine horn only, the oviduct ipsilateral to the ovary was also removed. Previous data from our laboratory demonstrated embryos of ewes subjected to this procedure remained in the contralateral horn until d 13. Control ewes (n=5) were hemiovariosalpingectomized and the remaining fimbria attached to the mesovarium of the adjacent ovary, assuring entry of oocytes into the ipsilateral horn only. Mated ewes were necropsied on d 15 and embryonic migration determined. Eight additional ewes, subjected to these surgical procedures, had adhered fimbria, failed to become pregnant and were excluded. All twenty ewes experienced embryonic migration. Since no biological variation was expressed following these treatments, no statistical analysis was conducted. These data demonstrated that neither local versus sytemic exposure to progesterone, nor embryos entering the ipsilateral versus contralateral uterine horns, influenced subsequent migration of ovine embryos into each uterine horn.

B. Physiological and endocrine traits associated with seasonality of breeding.

Experiment 1

Postpartum Fertility of Polypay, Dorset, St. Croix and Targhee Ewes in the Spring. W. F. Pope, K. E. McClure, D. M. Broermann, M. D. Bishop, D. E. Hogue and M. L. Day.

Seventy-nine mature Polypay (P), Dorset (D), St. Croix (SC) and Targhee (T) ewes lambed in the spring (February to March) and were randomly divided into groups which were weaned at lambing or after d 40 (d 0 = lambing). Through d 80, ewes were continuously exposed to rams of known fertility and blood samples collected every other day. Progesterone concentrations were determined for purposes of estimating days to the first normal estrous cycle, days to rebreeding (DTB) and/or loss of pregnancy (ABORT). The incidence of ewes lambing (LAMB) was coded: 1 = lambing and 0 = failure to lamb. Likewise, ABORT was coded: 1 = no ABORT and 0 = ABORT. Data were analyzed by use of an analysis of variance and means compared by use of a protected LSD. Interactions were not significant. Ewes weaned at lambing initiated estrous cycles sooner ($P<.001$) and DTB was shorter ($P<.05$) than ewes weaned at 40 d (26 and 42 d than 38 and 51 d, respectively). However, lactation improved ($P<.08$) the

percentage of ewes lambing (d 0 vs d 40 weaning; 38 vs 58%). Results of this experiment indicated Targhee ewes conceived sooner after spring lambing but failed to maintain their pregnancy relative to Dorsets.

	Weaned at Lambing				Weaned after 40 d				Breed Means		
Breed	DTB	ABORT	LAMB	n	DTB	ABORT	LAMB	n	DTB	ABORT	LAMB
P	40	.5	.3	10	56	.7	.7	10	48^{ab}	$.6^{abc}$	$.5^{abc}$
D	51	1.0	.7	9	50	.8	.7	10	50^{a}	$.9^{a}$	$.7^{a}$
SC	47	.7	.5	10	54	.6	.6	10	51^{a}	$.6^{ac}$	$.6^{ac}$
T	30	.2	.1	10	44	.4	.3	10	38^{b}	$.3^{bc}$	$.2^{bc}$

^{a,b} Different columned superscripts differ (P<.05).
^{c} Differ (P<.01).

II. Objective 2 of NC-111: Develop feeding strategies for sheep with high productive rates.

A. Evaluation of forage management systems for lamb and wool production.

Experiment 1

Red Clover in a Forage System for Sheep. R. W. Van Keuren and K. E. McClure.

A year-around forage system based on a red clover-orchardgrass mixture was compared with a semi-confinement system for sheep production at Wooster during 1983-1987. Late April-born lambs (from Targhee ewes bred to Hampshire rams) were put on pasture or remained in confinement with the ewes until weaning in early July. Following weaning, the pasture lambs remained on pasture until late summer without supplemental feed. The semi-confinement lambs remained in the barn on an all-concentrate diet (whole shelled corn and protein supplement). The 4-year average daily gain (ADG) of pasture lambs was .53 lb preweaning, .37 lb postweaning and .44 lb season long, with an end of grazing season live weight of 74 lb. The 2-year ADG of the confinement reared lambs was .86 lb preweaning, .66 lb postweaning and .73 lb season long, with a live weight of 99 lb coincident with the end of the grazing season. The first year when the pasture averaged 65% red clover, the pasture lambs had .73 lb ADG preweaning and .53 lb season-long, weighed an average of 93 lb off pasture, and a few lambs reached market condition. Each season the pasture lambs required some drylot feeding to reach market condition. The confinement lambs averaged 92 lb and reached market condition by late summer. Keeping the ewes in the pasture postweaning resulted in excessive gain and condition. After the second year ewes were fed hay in drylot following weaning where they remained until fall pasture was available. The pastures were stockpiled beginning in late August and provided excellent late fall pasture from late October until late December. Hay harvested from surplus pasture was fed to ewes during late summer and in winter following late fall grazing, but additional hay was needed. Red clover maintained an excellent stand for 2 years, reduced to an average of 32% in the third year. Sclerotinia markedly reduced the stand during the winter of 1985-86. Broadcast seeding of red clover in March in 1986 and 1987 was only marginally successful in improving red clover stands.

Table 2. Performance of lambs grazed on red clover-orchardgrass or feed in drylot and persistence of red clover

	Lamb ADG, lb			End		Red clover
Year	Pre-weaning	Post-weaning	Season-long	Wt. lb.	C.S.†	Avg. % of pasture D.M.
				Pasture lambs‡		
1984	.73	.44	.53	92.8	10.7§	65
1985	.46	.35	.37	77.9	9.2§	32
1986	.48	.44	.46	68.9	7.7¶	15
1987	.44	.24	.37	55.9	7.9¶	15
Avg.	.53	.37	.44	73.9	8.9	
				Confinement lambs††		
1985	.92	.57	.68	96.8	11.1	--
1986	.79	.75	.77	101.0	11.5	--
Avg.	.86	.66	.73	98.8	11.3	

† C.S.: Condition score, 1-15, 10-12 suitable for market.

‡ Lambs to pasture shortly after birth or born on pasture.

§ 1984 and 1985: Sold off pasture.

¶ 1986, 1987: Finished in barn after pasture.

†† Lambs born and reared in confinement barn.

Table 3. Red clover-orchardgrass summer grazing days and hay production†

	Ewes		Lambs				
			Preweaning		Postweaning		
Year	Total days Grazing	Dates	Total days Grazing	Dates	Total days Grazing	Dates	Hay Tons DM‡
1983	--	--	--	--	--	--	9.4§
1984	3024	5/02-8/31	2041	5/02-7/02	2632	7/7-9/25	6.4
1985	2184	4/26-8/15	1884	4/25-7/09	1398	7/9-8-24	9.6
1986	1246	5/07-7/02	1346	5/06-7/02	1224	7/2-8/22	10.4
1987	1532	4/28-7/22	1498	4/28-7/22	1022	7/6-8/21	11.3

† Total for 8.0 acres.

‡ Hay from paddocks not needed for grazing. Some additional hay needed each year to feed ewes.

§ Seeding year: All paddocks harvested for hay 7/14/83; two paddocks in each replicate cut again 9/2/83, and three paddocks left unharvested for late-fall grazing by ewes.

Table 4. Red clover-orchardgrass pasture as deferred fall/winter grazing for ewes.

Year	Acres	No. Ewes	Grazing period	Ewe days/ acre	Ewes/ acre	C.S.† Begin	C.S.† End
1983	4.8	29	10-17/11-21	211	6.0	3.3	3.5
1984	6.4	25	11-06/12-21	164	3.9	3.2	3.3
1985	8.0	25	10-21/12-23	197	3.1	3.0	2.8
1986	8.0	25	10-29/12-29	193	3.1	3.2	3.2
1987	8.0	25	10-29/01-12	234	3.1	3.6	3.0

† C.S.: Condition score, range 1-5.

Experiment 2

Comparison of Dissected Carcases from Lambs Grazed or Drylot Fed.

K. E. McClure, R. W. Van Keuren and P. G. Althouse

The effect of four paddock rotation grazing orchardgrass (OG), perennial ryegrass (RG), alfalfa (ALF) or a shelled corn, pelleted supplement diet in drylot (DL) on lamb carcass dissection and ether extractable (EE) fat was evaluated. Thirty-two Targhee lambs were randomly assigned by weight (wt) and sex (8 ewes, 8 rams) to 2 replicates for each treatment. Initial wts averaged 48 lb (ranged 46.9 to 49.9 lb). All lambs were slaughtered after 112 days when DL lambs reached .23 in live fat thickness. Half of each carcass was frozen and sawed into 1.0 in slices which were dissected to measure wts of muscle, fat and bone and then ground for analysis of EE fat. End live wts plus muscle and bone wts were the same for ALF and DL lambs and larger than OG or RG. Leg conformation (LC) was the same for ALF and DL and larger than OG and RG. Wts of chilled carcass (CC), loin, slices, dissectible and EE fat were larger for DL than ALF with OG and RG lambs smaller. Percent EE was largest for DL and decreased through ALF, OG and RG. Although CC and loin wts of ALF were less than DL the ALF carcasses had the same muscle wt with less fat.

Table 5. Live animal, carcass and loin weights and leg conformation.

Item	Orchardgrass	Ryegrass	Alfalfa	Drylot
End live wt. (lb)	76.1^{b}	68.6^{c}	109.1^{a}	110.9^{a}
Chilled carcass (lb)	26.2^{c}	22.7^{d}	48.6^{b}	52.8^{a}
Loin (lb)	$.9^{c}$	$.7^{c}$	2.2^{b}	2.6^{a}
Leg conformation[e]	8.7^{b}	7.6^{c}	12.1^{a}	11.8^{a}

[abcd] Means within a row with different superscripts differ (P<.01).

[e] Leg conformation = 7,8,9,10,11,12 = good-, good, good+, choice-, choice, choice+.

Table 6. Dissected muscle fat, bone and ether extract analysis of carcasses from lambs grazed or drylot fed

Item	Orchardgrass	Ryegrass	Alfalfa	Drylot
1 in slices, wt (lb)	11.9[c]	10.3[d]	23.3[b]	24.9[a]
Muscle, wt (lb)	6.2[b]	5.5[b]	11.4[a]	10.8[a]
Fat, wt (lb)	2.4[c]	1.8[c]	5.9[b]	8.6[a]
Bone, wt (lb)	3.5[b]	3.3[b]	5.1[a]	5.3[a]
Ether extract (%)	18.2[c]	14.3[d]	24.8[b]	33.0[a]
Ether extract (lb)	2.2[c]	1.5[d]	5.8[b]	8.2[a]

[abcd] Means within a row with different superscripts differ (P<.01).

III. Publications

McClure, K. E. and D. C. Mahan. 1988. Effect of dietary selenium source on retention, digestibility and wool accumulation of selenium in growing lambs. Nut. Rep. Int. 37:839.

McClure, K. E., R. W. VanKeuren and P. G. Althouse. 1988. Comparison of dissected carcasses from lambs grazed or drylot fed. Presented at Annual Meeting ASAS, Rutgers University, July 19-22, 1988.

VanKeuren, R. W. and K. E. McClure. 1988. Red clover in a forage system for sheep. In Proceedings of the 10th Trifolium Conference, Corpus Christi, Texas, March 24-25, 1988.

Nephew, K. P., D. M. Broermann, S. Xie, J. O. Jones and W. F. Pope. 1988. The effect of local versus systemic progesterone exposure and initial uterine location on embryonic migration in sheep. Presented at Annual Meeting ASAS, Rutgers University, July 19-22, 1988.

Nephew, K. P., S. Xie, D. M. Broermann, J. O. Jones and W. F. Pope. Factors affecting embryo migration in sheep. Presented at Annual Meeting ASAS, Rutgers University, July 19-22, 1988.

Pope, W. F., K. E. McClure, D. M. Broermann, M. D. Bishop, D. E. Hogue and M. L. Day. Postpartum fertility of Polypay, Dorset, St. Croix and Targhee ewes in the spring. Presented at Annual Meeting ASAS, Rutgers University, July 19-22, 1988.

OREGON STATE UNIVERSITY

1988 NC-111 Annual Report

Project Leader: Howard Meyer
Graduate Students: Rob Lewis, Mohammad Nawaz, Kathy West

I. Objective 1. Increase prolificacy and embryo survival and reduce seasonality in sheep.

A. Evaluation of ewes of Coopworth and/or Polypay origin.

A crossbreeding trial was initiated to compare Coopworth origin ewes with other popular/productive genotypes. Commercial Polypay and Coopworth-type ewes were mated to Coopworth, Polypay, and Suffolk rams to produce six genotypes of ewes. These were group mated to Hampshire rams to compare ewe reproductive performance and lamb growth across ewe genotype.

The 1988 lambing results for the six genotypes are shown in Table 1. It is interesting to note the large effect of dam gentotype of the ewes but relatively small effect of their sire genotype. Specifically, the daughters of Polypay and Coopworth sires had quite similar performance while the daughters of Polypay and Coopworth-type dams are quite different. This suggests that the sample of Coopworth genes acquired from the local Coopworth-type ewes may have been very different from Coopworth genes from the imported rams.

Such an explanation is supported by lambing results of an additional group of two-year-old Polypay and Coopworth x Polypay ewes which had very similar performance when mated to common rams (Table 2).

Table 1. Reproduction of crossbred ewes.

SIRE BREED	DAM BREED: POLYPAY			DAM BREED: COOPWORTH		
	No.	L.S.	% Lambing	No.	L.S.	% Lambing
Polypay	55	1.80	91	34	1.53	94
Coopworth	59	1.73	93	25	1.57	84
Suffolk	54	1.70	93	34	1.56	94

Table 2. Reproduction of Polypay vs Coopworth x Polypay Two-Year-Old Ewes

	Polypay	Coopworth x Polypay
No.	50	41
Litter Size	1.84	1.80

B. Factors affecting uterine efficiency and embryo survival.

A study was conducted with mixed-age Polypay ewes to examine the effects of pre-mating and post-mating nutrition on uterine efficiency (UE). Pre-mating treatments consisted of periods of high and low nutrition sufficient to produce ewes of high and low body condition (mean C.S. of 3.5 vs 2.2). Half of the low body condition ewes were flushed for 21 days pre-mating while the other half were immunized with Fecundin to increase ovulation rate. All ewes were synchronized with progestogen sponges.

Following mating, half of the ewes of each pre-mating group were placed on high nutriton (150% NRC) while the remainder were placed on low nutrition (80% NRC). All ewes were examined by laparoscopy 3 to 7 days post-mating to determine ovulation rate.

Mean litter size for ewes lambing to twin and triple ovulation is shown in Table 3. It appears that ewes in good body condition at the time of mating exhibited high uterine efficiency regardless of post-mating nutrition level (UE of .80 for twin ovulators and .77 for triple ovulators). Conversely, ewes in poor body condition and on low nutriton right up until mating (Fecundin group) exhibited lower UE, particularly for triple ovulators (UE = .15). Ewes flushed before mating showed inconsistent effects of post-mating nutrition on UE.

Table 3. Effects of pre- and post-mating treatment on litter size and uterine efficiency for ewes conceiving to twin (OR=2) and triple (OR=3) ovulations.

Pre-mating treatment	Post-mating treatment					
	High		Low		Mean	
	OR=2	OR=3	OR=2	OR=3	OR=2	OR=3
High condition	1.80 (n=10)	2.50 (n=6)	1.80 (n=5)	2.63 (n=8)	1.80 (n=15)	2.57 (n=14)
				UE =	.80	.77
Low condition Flushed	1.86 (n=7)	2.13 (n=8)	1.50 (n=8)	2.50 (n=10)	1.67 (n=15)	2.33 (n=18)
				UE =	.67	.66
Low condition Fecundin	1.60 (n=5)	1.75 (n=8)	1.63 (n=8)	1.80 (n=5)	1.62 (n=13)	1.77 (n=13)
				UE =	.62	.15
Mean LS	1.77 (n=22)	2.09 (n=22)	1.62 (n=21)	2.39 (n=23)	1.70 (n=43)	2.24 (n=45)
Mean UE	.77	.32	.62	.77	.70	.54

HHM/bv
9/13/88

South Dakota State University
1988 Station Report to NC-111

Objective 1 of NC-111: Improve prolificacy and embryonic survival and reduce seasonality in sheep.

A. Increased efficiency of sheep production - SD 221. Objective: Compare the lifetime performance of ewe breeds and breed crosses under farm flock and range flock management systems.

Experiment 1. The Effect of Management System and Breed of Ewe on Lamb and Wool Production (A. L. Slyter, K. F. Hoppe, Chris Faller and Ron Swan)

Preliminary results for the 1988 lambing season are shown in table 1. Approximately equal numbers of ewes are represented from each age group (2, 3 and 4 yr old at lambing). A slightly higher percentage of the Targhee ewes lambed than the FDT ewes. The FDT ewes continue to have a higher lambing rate, although the difference between the two groups appears to be narrowing. This appears to be the result of Targhee ewes continuing to increase in lambing rate with advancing age, while the FDT ewes may have plateaued. Little difference in lambing performance has been noted between the two management systems.

TABLE 1. LAMBING PERFORMANCE OF TARGHEE AND FINN-DORSET X TARGHEE EWES (1988 LAMBING)

Item	Breed of dam: Targhee	Breed of dam: Finn-Dorset x Targhee
Brookings Farm Flock		
No. ewes exposed	66	176
No. ewes lambing	63	161
Percentage lambing	95.4	91.4
No. lambs/ewe exposed	1.64	1.85
No. lambs/ewe lambing	1.71	2.02
Ewes lost, breeding to lambing	2	5
Antelope Range Flock		
No. ewes exposed	84	166
No. ewes lambing	80	156
Percentage lambing	95.2	93.9
No. lambs/ewe exposed	1.58	1.89
No. lambs/ewe lambing	1.66	2.01
Ewes lost, breeding to lambing	1	5

Wool cored from the Antelope flock tested 24.60 ± 4.42 microns (60's s.c.) for the Targhee and 26.90 ± 5.68 microns (56's s.c.) for the FDT ewes. The price differential at the time of sale (April 1988) was $.13 grease. Average grease fleece weights were 8.74 and 6.88 lb for the Targhee and FDT ewes, respectively.

B. Reproductive efficiency of sheep - SD 153. Objectives: Evaluate various treatmetns and/or management techniques to extend the breeding season.

Experiment 1. <u>Reproductive Performance of Anestrous Crossbred Ewes Subjected to Artificial Photoperiod or Melatonin</u> (Kelly Weiskircher and A. L. Slyter)

The effectiveness of artificial photoperiod or melatonin to induce estrus during summer mating was studied utilizing 41 Hamp x Finn-Targhee (HFT) and 42 Finn-Dorset x Targhee (FDT) ewes. Ewes were randomly allotted to one of four treatments, (1) natural daylight and a melatonin implant (Regulin) [ND+RI], (2) artificial photoperiod, 8 h light and 16 h dark (8L:16D), (3) natural daylight (ND) and (4) natural daylight + 3.5 mg melatonin (M) fed/ewe daily (ND+M). Length of the treatment period was 88 days (June 1 through August 26). Each treatment group was subjected to fenceline ram contact for 30 days prior to exposure to intact rams (July 1 through August 26). Rams were painted daily with a mixture of wool paint and grease. Breeding marks were recorded daily at feeding time. The mean number of breeding marks was greater (P<.05) for the 8L:16D ewes (2.3) than for the other three groups (1.1, 1.2, 1.2 for ND+RI, ND and ND+M, respectively). No breed, treatment or two-way interaction effects existed (P>.05) for mean days to first breeding mark, date of conception, lambing date or percentage of ewes lambing. Mean days to first breeding mark were 24, 16, 22 and 23; mean lambing dates were December 20, 17, 20 and 18; percentages of ewes lambing were 90, 100, 81 and 81 for ND+RI, 8L:16D, ND and ND+M, respectively. Lambs born per ewe lambing were not different (P>.05) among treatments or between

TABLE 1. REPRODUCTIVE PERFORMANCE OF EWES SUBJECTED TO ARTIFICIAL PHOTOPERIOD OR MELATONIN

Treatment	No. ewes	No. marks	Days to first mark	Lambing date[a]	Percentage lambing	No. lambs/ ewe lambing
ND + RI	20	1.1[b]	24	354	90	1.72
8L:16D	21	2.3[c]	16	350	100	1.67
ND	21	1.2[b]	22	354	81	1.47
ND + M	21	1.2[b]	23	351	81	1.71

[a] January 1 = 1.
[b,c] Means with different superscripts differ (P<.05).

breeds. Breed differences (P<.002) in initial and final weights were observed. However, weight gain during the course of the experiment did not differ (P>.05) among treatments or between breeds. In

conclusion, the higher than expected reproductive performance of control ewes may account for the lack of significant treatment effects.

<u>Publications</u>

<u>Thesis</u>:

Wolf, Anthony. 1987. The effect of photoperiod and melatonin on reproductive performance of anestrous ewes. South Dakota State University.

<u>Abstract</u>:

Wolf, A. M. and A. L. Slyter. 1987. The influence of photoperiod and melatonin on reproductive performance of anestrous ewes. J. Anim. Sci. 65(Suppl. 1):101.

Weiskircher, Kelly and A. L. Slyter. 1988. Reproductive performance of anestrous crossbred ewes subjected to artificial photoperiod or melatonin. J. Anim. Sci. (In press).

<u>Nonrefereed</u>:

Hoppe, K. F. and A. L. Slyter. 1987. The effect of exposure to teaser rams on lambing performance of Hampshire and Columbia ewes. S.D. Agr. Exp. Sta. SHEEP 87-4:13-14.

Slyter, A. L., K. F. Hoppe and Ron Swan. 1987. Lamb and wool production as influenced by breed of ewe, age and management system (Progress Report). S.D. Agr. Exp. Sta. SHEEP 87-1:1-3.

Wolf, A. M. and A. L. Slyter. 1987. The influence of photoperiod and melatonin on reproductive performance of anestrous ewes. S.D. Agr. Exp. Sta. SHEEP 87-2:4-9.

Wolf, A. M. and A. L. Slyter. 1987. The effect of melatonin dosage on reproductive performance in anestrous ewes. S.D. Agr. Exp. Sta. SHEEP 87-3:10-12.

Texas Agricultural Experiment Station

1988 Annual Report to NC111

Prepared by

Maurice Shelton

Objective 1. Increase the Efficiency of Reproduction and Growth in Sheep

A. Introduction of the Booroola Genotype to Fine-wool Sheep Flocks

The introduction of the "F" gene increased the ovulation rate by approximately 1 CL per ewe as compared to pure Rambouillet. This was greater than Finn x Rambouillet crosses. Booroola cross animals had noticeably more ewes with three or more ovulations (45.5) than Finn crosses (17.5) as compared with the pure Rambouillet at 2.1%. The lambing rates for the two crossbred groups did not differ significantly (2.04 for Booroola cross vs 1.91 for Finn cross), but both groups differed from the Rambouillet at 1.39. The Booroola cross group had more triplet or greater parturitions (23.6%) than the Finn crosses (14.6%), but this difference was less than in the case with ovulations. The Booroola crosses had an advantage over all the crosses as well as the pure Rambouillet in fleece weight and yield.

As expected with higher lambing rates lamb survival has proven to be a problem. In respect to the experimental flock this problem has been aggravated by a large number of deformed lambs in the 1987 lambing season which have been tentatively attributed to the virus known as Cache Valley Fever.

In the future a substantial part of the research with this flock will be devoted to methods to improve lamb survival.

B. The Use of Immunosuppression (Fecundin) to Improve the Lambing Rates of Range Ewes

Fecundin has been used on two experimental groups of ewes. The first group have been involved in the experiment for three consecutive years. With this group the average advantage for the treated ewes was 21.8% in lambs born, but the advantage at market was only 10.3%. These ewes were used for an additional year in which no booster injections were given. In this year there was no advantage for the group of ewes which had been previously treated. A second group of ewes have been used in a similar experiment for two years. With this group the advantage was 25.4% more lambs born, and 25.0% more weaned. In both experiments the lambs from the control ewes weighed heavier at weaning than those from the treated ewes.

C. Using Intact Rams to Improve Growth Rate and Yield Grade of Lambs

An experiment was conducted utilizing 99 lambs to investigate the growth, slaughter and carcass characteristics of wether lambs (castrated

at marking) versus intact ram lambs or ram lambs castrated by knife or burdizzo as they were placed in the feedlot. The data collected included rate of gain on feed, pelting difficulty, quality and yield grades and factors contributing to yield grade. The animals ranged up to 9 months of age and 134 pounds at slaughter. Gains were very poor on lambs castrated as they were placed on feed, and thus castration at this time would not be indicated. As expected, ram lambs gained more than wether lambs, but these data only cover the last six weeks before slaughter. Ram lambs had significantly lower dressing percent than the other groups. They also had significantly less backfat thickness. Ram lambs had lower (more desirable) yield grades. Late castrate animals were intermediate. All of the animals in the experiment graded "Choice, thus in this experiment there was no downgrading due to "buckiness". Pelting difficulty or pelting damage scores were not consistent or significant, but there was a tendency for males or late castrates to score higher (less desirable) in this respect. In this study, the only basis for discrimination against ram lambs was their lower dressing percent. Improvements in yield grades and the sale value of the testis could more than offset this difference. There is a need for further research under different conditions such as lambs of different breeding or those carried to heavier weights. The animals in this experiment were slaughtered at lighter weights than most of those being marketed at the present time.

D. Cottonseed Meal vs Soybean Meal for Early Weaned Lambs

In an experiment involving 101 early weaned lambs which were started on feed at an average of 43 pounds and 74 days of age there was no advantage from substituting soybean meal for cottonseed meal in high energy rations.

Publications

Willingham, T., M. Shelton and C. Lupton. 1988. Genotypic Influence on Reproduction and Fleece Traits When Introducing the Booroola Merino and Other Selected Breeds into Rambouillet Flocks. Texas Agri. Expt. Sta. PR(In press).

Willingham, T., M. Shelton and C. Upton. 1988. The Influence of Introducing the Booroola Merino Genotype to Rambouillet Flocks on Reproduction and Fleece Traits in Comparison With Other Selected Breed Crosses. SID Research Journal 4:1-5.

Shelton, M. and T.Willingham. 1988. Growth, Slaughter and Carcass Characteristics of Wether versus Ram Lambs or Rams Castrated as They are Placed in Feedlot. Texas Agri. Expt. Sta. PR(In press).

Shelton, M. and T. Willingham. 1988. The Booroola Merino. The Ranch Magazine. Mar 88.

Shelton, M. and T. Willingham. 1988. Growth, Slaughter and Carcass Characteristics of Wether versus Ram Lambs or Ram Castrated as They are Placed in Feedlot. Texas Agri. Expt. Sta. PR(In press).

Lupton, C.J. and M. Shelton. 1988. Should We be Selecting for Finer Wool? The present situation relative to the economics and genetics of selecting for fine fiber in wool. Texas Agri. Expt. Sta. Tech. Rpt. 88-2.

Shelton, M., T. Willingham and M.C. Calhoun. 1988. Soybean Meal vs Cottonseed Meal as a Source of Protein for Early Weaned Lambs. Texas Agri. Expt. Sta. PR(In press).

Objective I: Increase prolificacy and embryonic survival and reduce seasonality in sheep.

Experiment 1: Estrus and ovulation rates in St. Croix ewes in two climatic environments. (W.C. Foote, S. Wildeus).

A group of 12 to 15 mature St. Croix ewes were placed in confinement on both St. Croix (17°43"N 64°40"W) and Logan, Utah (41°46"N 111°40"W) and exposed to a sterile teaser ram. Ewes at both location were fed a pelleted ration (80% alfalfa, 20% barley; obtained from the same source) according to 90% of NRC requirements. At both locations ewes were observed for estrus daily, and the occurrence and rate of ovulation was examined monthly using laparoscopy. Body weights and condition scores were recorded monthly.

Table 1
Seasonal variation in reproductive measurements in St. Croix ewes on St. Croix and in Utah.

Month	n	Body weight (lbs)	Body cond.[1]	Estrus occur. (%)	Ovulation occur. (%)	Ovulation rate	Daylight (hr)
St. Croix (17°43"N 64°40"W):							
JUL	15	92.5	--	100.0	100.0	1.9	13.02
AUG	15	91.5	--	100.0	100.0	2.1	12.63
SEP	15	96.7	4.40	100.0	100.0	2.1	12.13
OCT	15	102.5	4.52	100.0	100.0	2.3	11.65
NOV	13	99.8	4.17	100.0	100.0	2.0	11.25
DEC	13	99.6	4.65	100.0	100.0	2.1	11.07
JAN	13	100.3	4.00	100.0	84.6	2.0	11.67
FEB	13	100.0	3.77	84.6	100.0	1.9	11.67
MAR	13	101.3	4.31	100.0	100.0	2.0	12.12
APR	13	102.1	4.08	84.6	100.0	1.9	12.63
Utah (41°46"N 111°50"W):							
JUL	13	--	--	0	15.4	2.0	14.80
AUG	13	--	--	69.2	76.9	2.0	13.63
SEP	12	117.9	5.06	100.0	84.6	2.3	12.75
OCT	12	121.0	4.17	100.0	100.0	2.3	10.85
NOV	12	117.7	5.25	100.0	100.0	2.2	9.63
DEC	13	121.2	4.92	100.0	100.0	2.2	9.12
JAN	14	119.9	4.79	100.0	100.0	2.3	9.65
FEB	13	123.4	5.08	100.0	100.0	2.2	10.87
MAR	14	125.6	5.36	100.0	100.0	2.2	12.18
APR	14	130.0	5.46	64.3	78.6	1.8	13.62

[1] score of 1-9 with 9 the highest condition score

Results of the first 10 months of the study are summarized in Table 1. Estrus and ovulation generally occurred in all ewes on St. Croix throughout this period (except only 84.6% showed estrus in February and March, and only 84.6% ovulated in January). However, none of the ewes in Utah showed estrus and only 15% ovulated in July. These values increased to 69.2% and 76.9%, respectively, in August. All of these ewes continued to cycle until April, when only 64.3% and 78.6% of the ewes showed estrus and ovulated, respectively, initiating seasonal anestrus. The amount of daylight decreased by only 2 hours between July and December on St. Croix, while it decreased by approximately 5.5 hours in Logan during the same time period.

Ovulation rate, based on the number of ewes ovulating, did not vary throughout the year, indicating no seasonal influence on ovulation rate. The ovulation rate was usually 2.0 or higher in most months at both locations.

Body weights tended to be heavier and body condition scores higher in the ewes at Logan. However, fluctuations in bodyweight were similar for ewes at both locations.

Experiment 2: Reproductive performance of St. Croix ewes in two climatic environments. (W.C. Foote, S. Wildeus).

In a second experiment of this study groups of approximately 20 ewes were exposed to a 35 day breeding season starting November 1, 1987. Again ewes at both locations were fed the same pelleted ration as in exp.1 according to 90% of NRC requirements. Body weight and condition changes and lambing performance of the ewes and pre-weaning growth rates of the lambs were recorded. Collection of all data is not completed at this point.

Table 2
Reproductive performance of St. Croix ewes on St. Croix and in Utah (1987-88).

	St. Croix	Utah
n	19	21
Age at lambing (yrs)	>2	2
Parturition date	4/03/88	4/13/88
Fertility (%)	94.7	100.0
Prolificacy (%)	194.0	176.0
Fecundity (%)	184.0	171.0
Lambs born alive (%)	94.3	97.3
Gestation length (days)[1]	147.6 ± 0.6	148.7 ± 0.3[2]
Lamb weight/ewe lambing (lbs)[1]	11.5 ± 0.7	12.4 ± 0.3
Type of birth		
singles (%)	16.7	23.8
twins (%)	72.2	76.2
triplets (%)	11.1	0.0

[1] mean±SEM
[2] gestation data available for 3 ewes

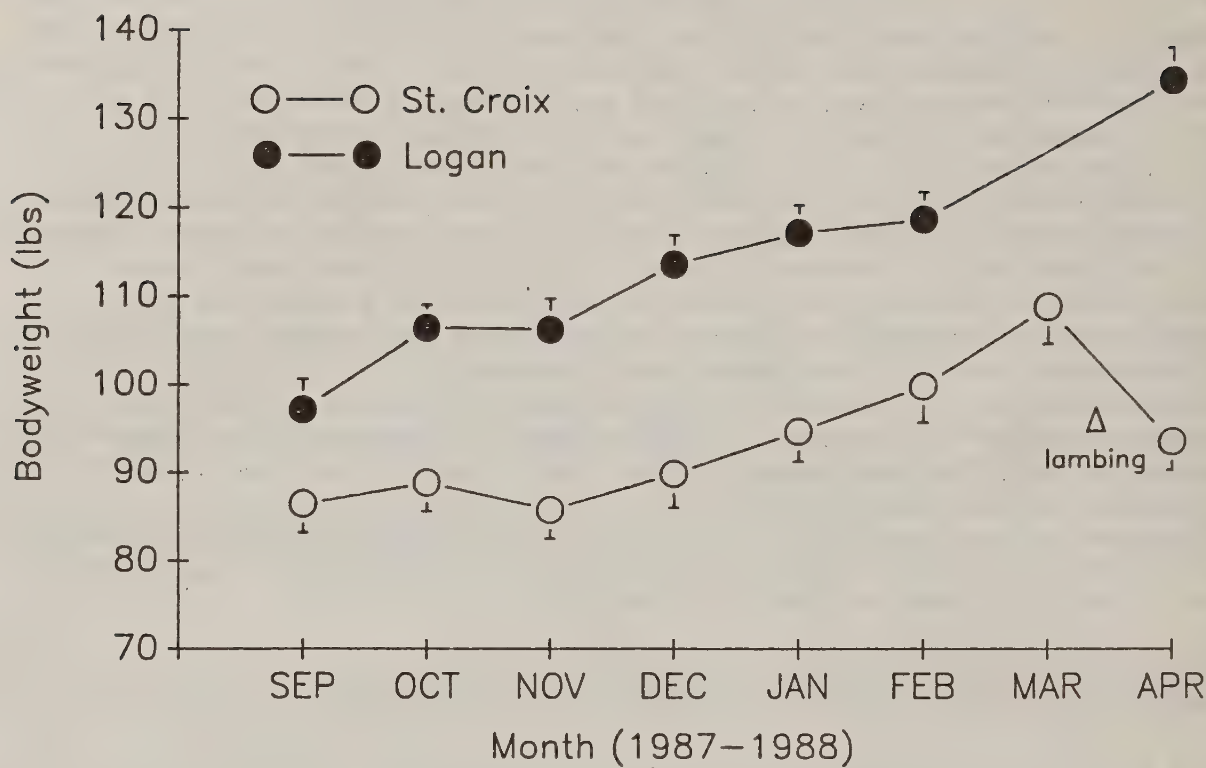

Figure 1
Body weight changes in St. Croix ewes during gestation on St. Croix and in Utah (1987-88).

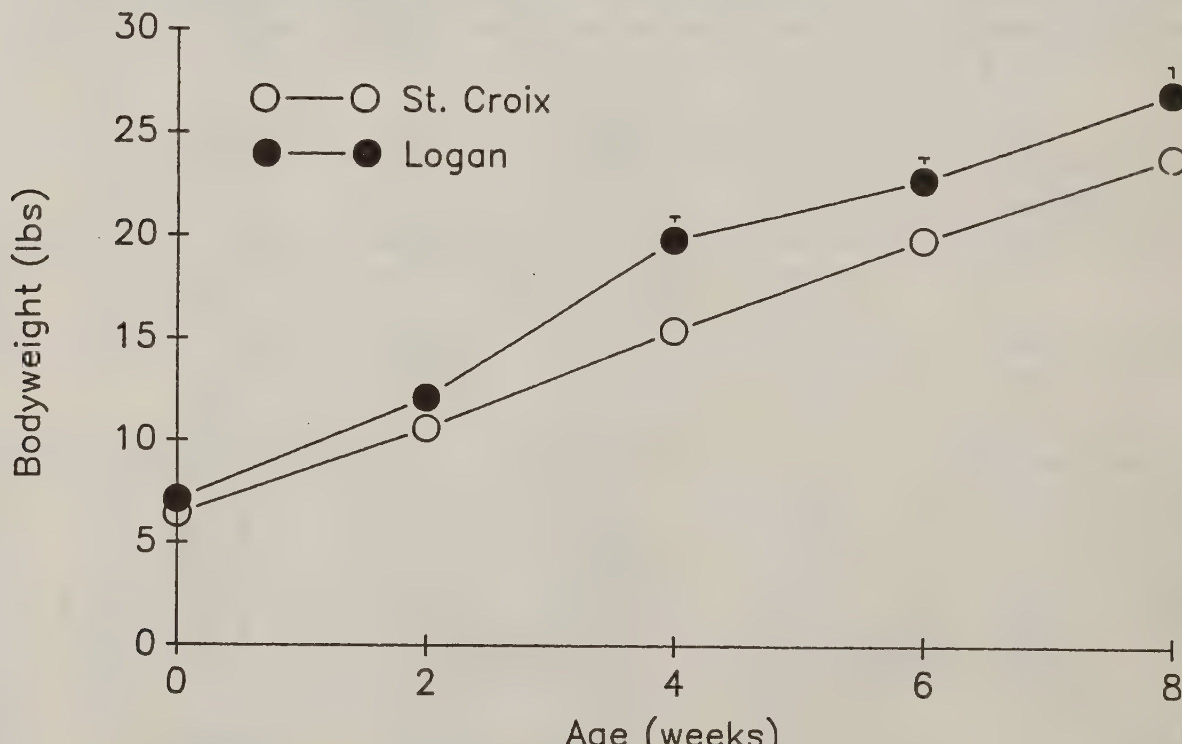

Figure 2
Pre-weaning growth in St. Croix lambs on St. Croix and in Utah (1987-88).

Preliminary results on weight changes in the ewes throughout gestation are presented in Figure 1. Body weight was lower in the ewes on St. Croix, but fluctuated at both locations according to stage of gestation. Groups at both locations had a similar relative increase in body weight.

Data on lambing performance are summarized in Table 2. Location appeared to have only a limited effect on fertility, prolificacy and fecundity. Lambs born alive were 94.3% and 97.3%, in St. Croix and Utah, respectively, and the amount of lamb born per ewe lambing was slightly higher in Utah. The frequency of single and twin birth was similar, and the absence of triplet birth in Utah is likely to be the result of the younger age of the ewes at Utah.

Changes in individual lamb body weights (unadjusted for sex and type of birth) are shown in Figure 2. Body weights were higher in Utah and lambs grew at a slightly faster rate.

All of the above measurements in experiments 1 and 2, plus postweaning growth rate and age at puberty in the lambs, will continue for a two year period. Additional data will be collected on endocrine profiles in various season, the post partum interval and on seasonal variations in ram reproductive parameters in the two climatic environments.

Experiment 3: Effects of pre-breeding supplementation on the reproductive performance of multiparous St. Croix ewes. (S.Wildeus, A. Schuster, K.T. Traugott, J.R. Fugle).

In this experiment 20 mature, multiparous ewes, nursing lambs, were divided into control and treatment groups 4 weeks before the beginning of breeding (Sept. 9, 1987). All ewes were run on the same pasture throughout the day and were separated in the evening, when the treatment group received a cracked corn supplement (8% crude protein, 3% crude fiber and 3% crude fat) at a level of 2.0 lbs/head/day. After four weeks, at breeding, supplementation ceased and the lambs were removed from their dams. For breeding, all ewes were exposed to a painted ram and breeding dates were recorded. Within 5-10 days following breeding

Table 3
Body weight and condition (mean+SEM)in ewes on pasture only or supplemented with corn prior to the onset of breeding.

	Supplemented	Control
Beginning of flushing:		
Weight (lbs)	83.0±4.1	80.9±3.4
Condition (1-9)	3.89±.26	4.44±.17
After flushing:		
Weight (lbs)	87.3±3.9	74.2±2.9
Condition (1-9)	4.11±.26	2.66±.24
End of breeding:		
Weight (lbs)	89.0±4.1	76.2±2.1
Condition (1-9)	4.44±.50	3.00±.24

ewes were examined by laparoscopy to determine ovulation rate. During the supplementation and breeding period, body weight and condition were recorded weekly. At lambing, the number of ewes lambing and the number of lambs per ewe were recorded.

Table 4
Reproductive characteristics (mean±SEM) of ewes on pasture only or supplemented with corn prior to the onset of breeding.

	Supplemented	Control
Days to first estrus	2.6±0.8	8.9±2.1
Ovulation rate	2.00±0.19	1.78±0.22
Number of lambs/ewe lambing	1.50±0.18	1.57±0.18
Number of lambs/ewe exposed	1.33±0.23	1.22±0.28
Days of gestation	149.0±0.7	148.4±0.7

All ewes were of similar body weight and condition at the beginning of the experiment. Supplemented ewes gained 4.3 lbs during the treatment period, while the ewes on pasture-only lost body weight (6.7 lbs) and condition (Table 3). Both groups generally maintained body weight and condition throughout breeding (Figure 3). There were no significant advantages in supplementing with corn on reproductive characteristics (Table 4), except for the fact that supplemented ewes were bred earlier ($P<.05$) in the breeding season.

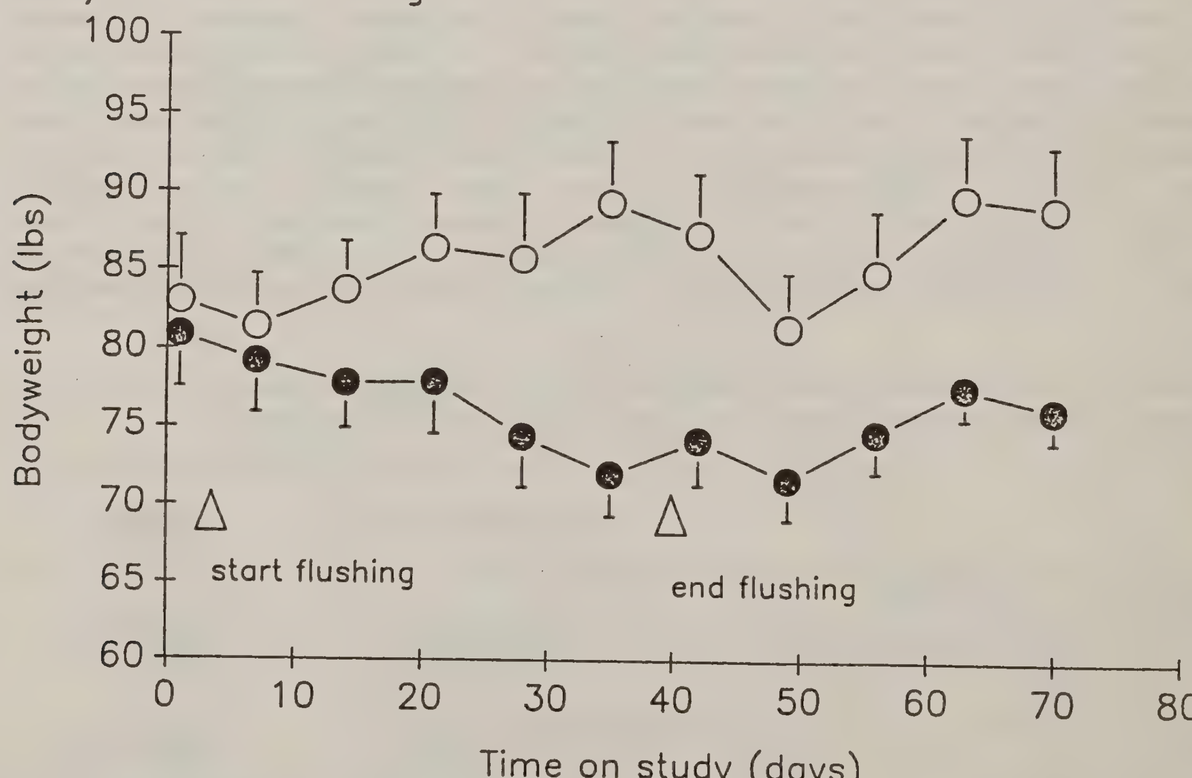

Figure 3
Weight changes in mature St. Croix ewes following supplementation with corn.

Experiment 4: Puberal development in St. Croix ewe and ram lambs under native conditions. (S. Wildeus, K.T. Traugott, J.R.Fugle, A. Schuster)

For this study 10 ewe and 10 ram lambs were placed in confinement immediately following weaning at approximately 9 to 11 weeks of age. Both groups were fed a diet of low to medium quality pangola grass (*Digitaria decumbens*) hay free choice and were supplemented with a commercial supplement (16% protein) at a rate of 2% of bodyweight. On this ration ewe lambs gained 0.11 lbs/day and ram lambs 0.17 lbs/day (Figure 4).

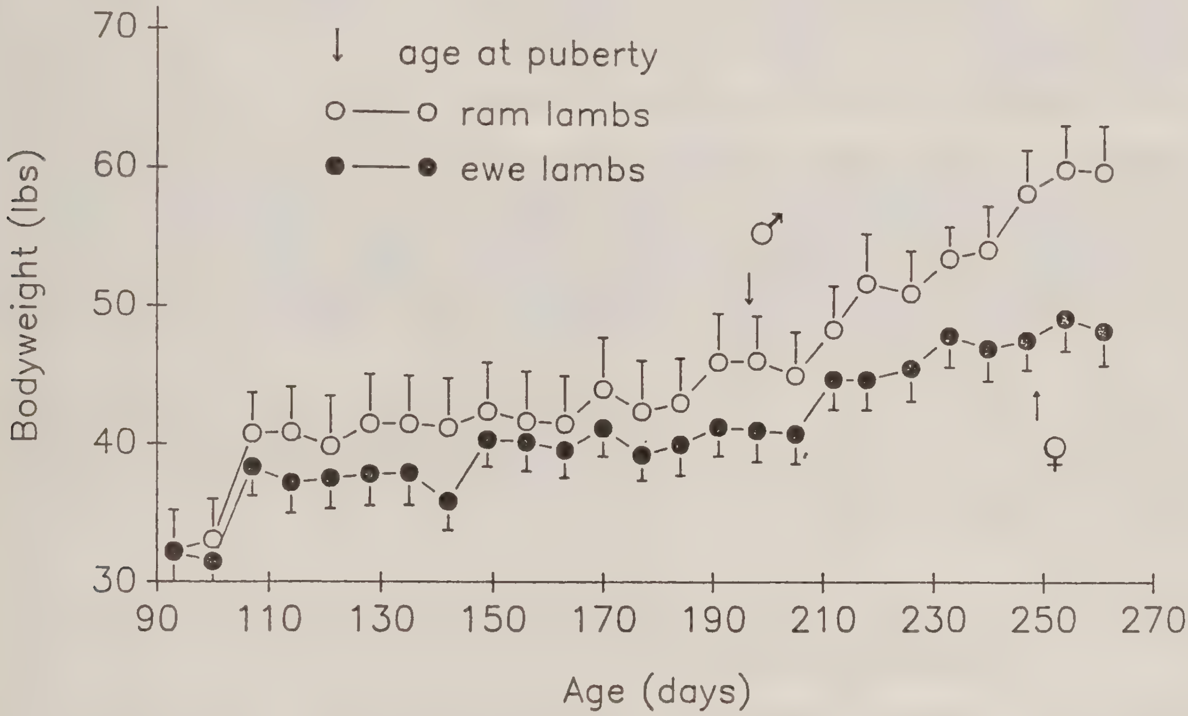

Figure 4
Postweaning growth and age at puberty in St. Croix ram and ewe lambs.

Ewe lambs were placed with a sterile marker ram and were observed for estrus daily. Upon observation of estrus, ovulation was confirmed by serum progesterone levels and ovulation rate determined by laparoscopy. The first behavioral estrus, in conjunction with elevated progesterone and presence of a corpus luteum on the ovary within 5 to 10 days after estrus, was used as an indicator of puberty.

In ram lambs, scrotal circumference was recorded at weighing and rams reaching 18 cm in scrotal circumference were electroejaculated in weekly intervals until an ejaculate with greater than 5 million spermatozoa and 10% motility was obtained. This was used as measure of puberty in the rams.

Both ewe and ram lambs reached puberty at a similar weight of 47 to 51 lbs (Table 5), but differed ($P<.001$) considerably in age. Ram lambs were 6.7 months at puberty, while ewe lambs were 2 months older (8.7 months). Among the ewe lambs, twins were 7.9 lbs lighter ($P<.10$) and were 40 days older ($P<.01$) than single lambs at puberty.

Table 5
Puberal characteristics of St. Croix ram and ewe lambs on a low to medium plane of nutrition.

	Rams	Ewes		
		Singles	Twins	Combined
Bodyweight (lbs)	47.1	57.0	49.1	51.4
Age (days)	204	237	277	265
Scrotal cir. (cm)	21.4	--	--	--
Ovulation rate	--	1.2	--	--

Except in the case of one ewe with two corpa lutea, first estrus was associated with a single ovulation in the remainder of the ewe lambs. In 90% of the ewe lambs, first behavioral estrus was preceeded by elevated progesterone concentrations (>0.5 ng/ml) indicating that first estrus was preceeded by a silent ovulation. Peak progesterone concentrations in the ewe lambs ranged from 0.50 to 2.89 ng/ml.

In the ram lambs, scrotal circumference increased in a curvilinear fashion with an accelerated growth during the puberal period of 180 to 230 days. Scrotal circumference averaged 21.4 cm at puberty, with a range of 20.0 to 22.5 cm, and was correlated with both age and weight.

Objective II: Develop feeding strageties for sheep with high reproductive rates.

Experiment 1: Growth and carcass characteristics of weaned St. Croix lambs on pasture supplemented with corn or coconut meal. (S. Wildeus, K.T. Traugott, J.R. Fugle).

A total of 51 ram and ewe lambs were allocated to groups fed either native Guinea grass (*Panicum maximum*) pasture only (n=17), or receive 0.5 lbs/head/day cracked corn (n=17) or coconut meal (n=17) supplement in addition to pasture grazing. The composition of the supplements is indicated in Table 6.

Table 6
Feed composition of the supplements.

	Cracked corn	Coconut meal
% dry matter	88.0	88.8
% crude protein	8.7	23.5
% crude fiber	2.2	8.7
% crude fat	>3.0	6.4

All animals were grazed as one group throughout the day and separated into respective treatment groups when they were penned in the evening. Pastures were changed three times during the trial as part of the rotational grazing system. Each treatment group consisted of castrated males weaned shortly before the start of the experiment (7/group), long-term weaned ewe lambs, previously grazed on pasture without supplementation (6/group) and ewe lambs weaned shortly before the start of the experiment (4/group), with an average age of 93, 221 and 83 days, respectively, at the onset of the study. Ewe lambs were kept on the study until they reached approximately 60 lbs body weight, and all castrated male lambs were fed to approximately 65 lbs, at which point they were slaughtered and carcass characteristics recorded. The weight of 65 lbs was chosen to represent the maximum weight at which weaned lambs are generally marketed for slaughter on St. Croix.

At the onset of the experiment animals receiving the coconut meal supplement failed to consume all the coconut meal offered, while the animals receiving the corn had little difficulty adjusting to the supplement. This initial adjustment phase extended over a period of two weeks, after which only sporadic refusal of supplement was noticed.

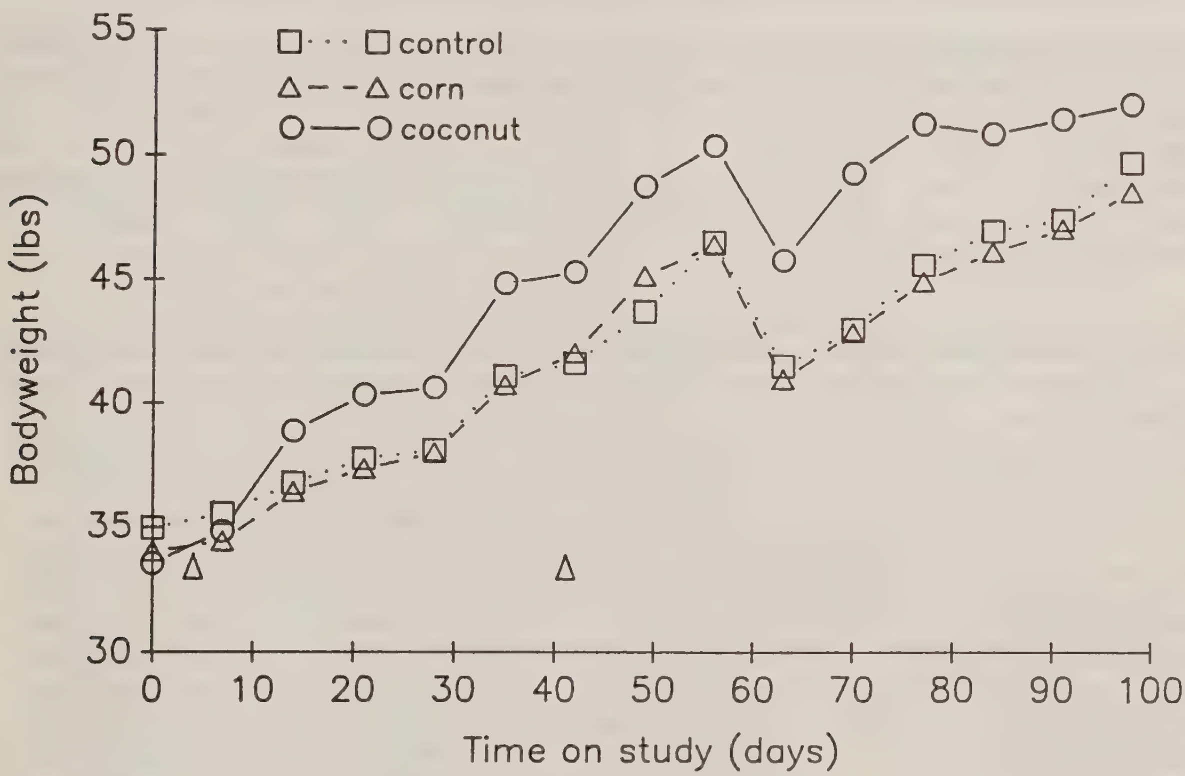

Figure 5
Growth patterns of St. Croix lambs grazing pasture only, or receiving supplements of corn or coconut meal.

The growth patterns of the animals in the three treatment groups are shown in Figure 5. Animals supplemented with coconut meal displayed a slightly faster rate of growth, then those receiving corn supplement or pasture only. When the data were broken down into the subgroups, a varied response to the feeding treatments was observed (Table 7). In all subgroups the animals

Table 7
Growth characteristics (mean±SEM) of St. Croix lambs of different sexes and stages of development fed pasture only, or pasture with corn or coconut meal supplement.

	Control	Corn	Coconut
Castrate males:			
days on feed	142±7	134±5	119±12
total gain (lbs)	33.2±1.7	34.2±2.6	37.0±3.9
ADG (lbs/day)	0.23±.006	0.25±.014	0.32±.023
Long-term weaned females:			
days on feed	76±25	68±21	69±19
total gain (lbs)	15.8±3.6	15.8±2.2	16.3±2.6
ADG (lbs/day)	0.25±.031	0.36±.104	0.34±.083
Short-term weaned females:			
days on feed	158±18	161±9	131±31
total gain (lbs)	32.7±3.8	35.3±1.3	33.3±5.5
ADG (lbs/day)	0.21±.004	0.22±.014	0.28±.033

on pasture generally stayed on feed longest, had the lowest total gain and average daily gain. However, only coconut meal supplementation resulted in a significantly higher ($P<.01$) average daily gain, compared to the corn supplementation in the castrate male group. Average daily gain in females put on study at an older age was similar between the two types of supplementation.

Table 8
Carcass characteristics (mean±SEM) of castrated St. Croix male lambs fed pasture only, or pasture with corn or coconut meal supplement.

	Control	Corn	Coconut
Liveweight (lbs)	64.0±0.8	65.7±0.6	64.4±0.6
Carcass weight (lbs)	26.4±0.4	27.8±0.6	27.3±0.6
Dressing percentage (%)	40.7±0.6	42.2±0.9	42.3±0.8
Kidney fat (lbs)	0.55±0.04	0.77±0.10	0.68±0.07
Ribeye (sq. in.)	1.65±0.08	1.67±0.08	1.50±0.11
Backfat (in.)	0.047±0.02	0.064±0.02	0.091±0.02

The carcass characteristics of the castrated males are presented in Table 8. There were no significant differences between the three feeding groups. All animals slaughtered at the target weight of 65 lbs had a relatively low dressing percentage (40.7 to 42.3%), and the carcasses were very lean.

Beltsville Aricultural Research Center
1988 NC-111 Annual Report

Objective II: Evaluate the efficient use of alternative feed resources to meet nutritional needs of sheep with increased genetic potential for reproduction and protein synthesis.

Project Title: Nutritional requirements of ewes with high production rates.

Protein metabolism in gestating ewes:

Future research:

1. Attempt to improve nitrogen retention in lactating ewes by feeding protected lysine and methionine.

2. Attempt to identify the specific proteins in liver and muscle cells that are catabolized in support of milk synthesis.

Carcass evaluation of young ram lambs:

Experiments have been conducted with the object of utilizing ram lambs in more efficient management systems. Feeding trials with young ram lambs in which protein and forage contents were varied showed that increased protein content from 11.2 to 19.0% and decreased roughage (alfalfa) content from 78 to 56% allowed young ram lambs to attain market weight in 120 days from birth. Since this work was exploritory in nature, the possibility of improving this diet and decreasing days to market is promising. A management system of this type utilizing the rapid growth rate and increased yield of lean meat from young ram lambs in a rapid turnover management system would increase the efficiency of lamb production. Previous work has shown that young ram lambs fed high roughage diets will produce carcasses with <.30 cm., of subcutaneous fat with a 22% higher content of unsaturated fatty acids than comparable castrate lambs. The more favorable ratio of unsaturated:saturated fatty acids along with a reduction in total fat content in the lean tissue of these ram lambs more closely meets human health needs than meat from castrates.

Several post mortem carcass treatments were used in an effort to improve the tenderness and to reduce the effects of cold shortening in the lean carcasses of these young ram lambs. Treatments included a control, post mortem electrical stimulation, covering the warm carcass with an insulated bag to prevent rapid heat loss, pelvic suspension of the carcass immediately after slaughter and electrical stimulation combined with the above treatments.

Effect of Postmortem Treatment Methods on Warner Bratzler Shear Force of Longissimus Dorsi and Rectus Femoris Muscle Samples from Young Ram Lamb Carcasses

	Longisimus dorsi		Rectus Femoris	
Post-mortem treatment	Shear value	Difference	Shear value	Difference
Control	7.28[1]		6.37	
Electrical stimulation	5.95	18.3	5.29	16.9
Insulated bag	5.25	27.9	4.97	22.0
Pelvic suspension	5.96	18.1	6.10	4.2
Elect. stim + bag	4.39	39.7	4.94	22.4
Elect. stim + suspension	4.88	33.0	5.05	20.7

[1]A Warner Bratzler shear value obtained using a 1.27 cm core sample. A value of <5.0 kg indicates optimal tenderness.

Substantial reductions in Warner Bratzler shear scores (increased tenderness) occurred when carcasses from these young ram lambs were subjected to post mortem electrical stimulation and cooled in an insulated bag or were hung by pelvic suspension. Some improvement in tenderness was also noted by use of either electrical stimulation or the insulated bag. These results show that the quality and nutritional value of ram lamb carcasses can be equal to or surpass carcasses of castrates in terms of consumer needs as well as obtaining a more efficient approach tomeat production for sheep rpdocuers.

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Lynch, G. P., T. H. Elsasser, T. S. Rumsey, C. Jackson and L. W. Douglas. 1987. Nitrogen metabolism of lactating ewes and their lambs. J. Anim. Sci. Submitted for publication.

Lynch, G. P. 1987. Ewe Nutrition, Proc. Annual Meeting, Virginia State Feed Assn., Roanoke.

Lynch, G. P., C. Jackson, Jr. and L. W. Douglas. 1987. Nitrogen metabolism and circulating amino acids of gestating ewes. Nutr. Rep. Intl. 37:995 (1988).

Solomon, M. B. and G. P. Lynch. The combined effect of electrical stimulation and carcass posture or insulated bags on ram lamb muscle tenderness. J. Anim. Sci. Ann. Mtg. 1988. Rutgers Univ., New Brunswick, NJ.

Norton, S. A., G. P. Lynch and J. A. Bohrer. Influence of whole rapeseed and rapeseed meal on thyroxine metabolism in growing ram lambs. 1988. FASEB Mtgs., Las Vegas, NV.

U S SHEEP EXPERIMENT STATION
1988 Annual Report to NC-111
(For Calendar Year 1987)

OBJECTIVE 1: Increase the efficiency of reproduction in sheep.

A. Breeding Season

Project 1.

EVALUATE METHODS OF GENETICALLY IMPROVING RESPONSE TO OUT-OF-SEASON BREEDING

Personnel: S.K. Ercanbrack

Objective: Compare alternative mating procedures combined with selection for improving lamb production from out-of-season breeding.

Experimental design: Polypay line 72 (150 ewes) and Rambouillet line 10 (160 ewes) are each being selected for response to spring breeding. Rams are being selected on the basis of minimum regression of testes size over a period 3 mo prior to breeding. The Booroola fertility gene will be introduced into 1/2 the Rambouillet line in the spring of 1988 by crossing with known homozygous Booroola Merinos. This is a revision of previously described procedures. The response to this introduction will be measured by comparing the 1/2 Booroola offspring (all carriers) with Polypay and Rambouillet purebreds.

Results: Each year since 1985, Rambouillet line 10 and Polypay line 72 have been mated, along with other Polypay lines, in April. Fertility in 1985, 1986 and 1987, respectively, was 23.0, 56.8 and 69.0% for line 10; 39.7, 64.1 and 73.1% for line 72; and 40.2, 40.6 and 76.8% for Polypay control groups. Similarly, prolificacy was 113, 144, 165% for line 10; 128, 155 and 164% for line 72; and 129, 171 and 160% for the Polypay controls. Lambs weaned per ewe exposed were 23.4, 64.4 and 97.9% for line 10; 45.1, 86.0 and 104.4% for line 72; and 44.5, 61.4 and 109.4% for the Polypay controls. Ewes were in somewhat poorer breeding condition in 1985 than in later years, which may explain some of the apparent improvement in prolificacy for 1986 and 1987. It appears, superficially, that some genetic improvement in response to April breeding is being made, although adaptation to the altered breeding season may also be a contributing factor. There has been intensive culling of ewes not lambing to the April breeding. Approximately 65 1/4-Booroola ewes will be mated for the first time in April 1988. At best, only half of these ewes will be carriers of the F gene.

Project 2.

EFFECTS OF EXTENDED LIGHT AND MELATONIN ON SPRING BREEDING OF EWE LAMBS

Personnel: J.N. Stellflug and J.A. Fitzgerald

Objective: Determine the effects of long light and melatonin on time and number of estrous cycles and reproductive performance of Polypay ewe lambs during spring breeding.

Experimental design: Ewe lambs (n=184) were allotted to: 1) ambient controls (AC), 2) 12 wk, 16h light followed by melatonin implants (16L+80dMI). Melatonin implants (Regulin) were supplied by Gene Link, Australia, Inc. Breeding was from Apr 1 (40d after treatment onset) to April 27. A Polypay ram was used as the breeding sire.

Results: We reported in 1986 that fertility rates of fall-born ewe lambs were increased to 58% with extended light plus melatonin (Regulin) compared to 5% fertility of ambient control ewe lambs. However, ambient control and 16L + 80d MI ewe lambs failed to lamb in 1987. The reasons for response differences between 1986 and 1987 are not known at this time. The 1987 ewe lambs were approximately 2 weeks younger than the lambs in 1986, but the 1987 lambs had reached the same body weight as the 1986 lambs at time of breeding. Evaluation of biweekly blood samples for progesterone indicated the ewe lambs failed to cycle until late April.

Project 3.

EFFECTS OF MELATONIN VS AMBIENT LIGHT ON SPRING BREEDING OF MATURE EWES

Personnel: J.N. Stellflug and J.A. Fitzgerald

Objective: Determine the effect of 40d melatonin implants vs ambient light on ovulation rate, onset of anestrus, number of estrous cycles, fetal loss, fertility and fecundity of mature Polypay ewes.

Experimental design: Mature Polypay ewes (171) were randomly allotted across all ages to either 40d melatonin treated group or an ambient control group. Thirty-three of the ewes were exposed to vasectomized rams and heat was checked every other day. Ovulation rate was monitored on the marked ewes on a weekly basis by laparoscopy. The rest of the ewes were bred from March 24 to April 27. Blood samples were collected twice a week from March through May for progesterone and protein B analyses in the bred ewes. Blood samples were collected twice a week from March through July in the non-bred ewes.

Results: Number of ewes lambing/ewe present at lambing was not different (P>.10) between ambient controls (76.8%) and melatonin-treated ewes (79.4%). Number of lambs born/ewe lambing was not different (P>.10) between ambient control (1.60) and melatonin-treated ewes (1.66). Number of corpra lutea/ewe averaged 1.44 for controls and 1.68 for melatonin-treated ewes when laprascopy was performed at 40d after breeding indicating an increased ovulation rate in the melatonin treated ewes but not lambs born/ewe lambing. Progesterone and protein B still have to be measured. For the nonbred ewes, the percent of ewes which were cycling as determined by laparoscopy were 100 vs 93 for controls (n=16) and melatonin-treated ewes (n=15) respectively, during April and May. In June, 56% vs 53% of the control and melatonin-treated ewes, respectively were cycling compared to 25% vs 7.1% during July. The average ovulation rates for control ewes vs melatonin-treated ewes (2.52 vs 2.11, 2.64 vs 2.67, 2.44 vs 2.33, 2.00 vs 2.00) for April, May, June and July, respectively, were not different. Samples are being assayed for progesterone to verify CL function.

Project 4.

EFFECT OF THE BOOROOLA F-GENE ON SEASONALITY IN POLYPAY EWE LAMBS

Personnel: J.N. Stellflug and J.A. Fitzgerald

Objective: Determine the effect of absence or presence of the F gene on seasonality.

Experimental design: Fall born ewe lambs from Polypay ewes bred to Booroola x Rambouillet rams which were thought to carry one copy of the F-gene were assigned to either an ambient control group or an extended light plus melatonin treated group. Ovulation rate, onset of puberty, number of estrous cycles and onset of anestrus were monitored or are in the process of being evaluated. In addition, the ovulation rates were observed for two consecutive estrous cycles in the fall when the ewes were about 1.5 yr of age.

Results: Laparoscopy data indicated 91.2% (n=34) of the treated ewe lambs had at least 1 CL during April, May or June compared to 52.9% (n=34) of the control ewe lambs. Evaluation of ovulation rates indicated that only 2 out of 7 sire groups had greater than 2 CL per ovulation. In the fall at 1.5 yr of age ovulation rates for the same 2 sire groups averaged between 2.5 and 3.1 with the other sire groups averaging less than 2 CL/ovulation time. Serum progesterone is being analyzed to verify the life span of the CL and onset of puberty and anestrus. Therefore, the day length manipulation treatment stimulated more ovarian activity in the ewe lambs and was helpful to obtain a better estimate of the F-gene carrier sire groups of ewe lambs. However, more observations are required on the ewes sired by predicted F-gene carrier rams before the effect of absence or presence of the F gene on seasonality can be determined.

Project 5.

EFFECTS OF CONTROLLED LIGHT TREATMENTS ON SPERM CHARACTERISTICS OF RAMS

Personnel: J.A. Fitzgerald and J.R. Mole

Objective: Develop improved in vitro semen tests for more accurate evaluation of fertility of rams both in and out of the normal breeding season.

Experimental design: Thirty to 40 rams of the Rambouillet, Columbia, Booroola Merino and Polypay breeds were maintained under controlled light treatments consisting of alternating 16-week periods of long (16 h) or short (8 h) days. Semen was collected weekly by artificial vagina. Ejaculates under different photoperiods were evaluated by classical semen evaluation techniques (motility, morphology, etc.) Three additional measures of sperm function, acrosome stability, motility through cervical mucus and ovum penetration were also evaluated. Acrosome reactions were visualized by epifluorescence microscopy after FITC - Con A binding. Cervical mucus penetration was evaluated after migration of sperm through a capillary pipette containing bovine mucus. A heterologous hamster egg penetration assay was used to assess sperm-egg interactions.

Results: Initial studies showed that sperm attachment on the egg was inversely related to penetration rate. Migration of sperm in

cervical mucus was less in long day compared with short day collected samples. Head to head clumping of sperm after exposure to cervical mucus occurred more frequently in long day (55/84) vs short day (4/31) samples. The acrosomal reaction was induced in 88-95% of sperm incubated in vitro. Components of sperm quality of light regulated rams may be related to marked differences in ram fertility (19-75%) noted from breeding trials conducted in March and April. Sexual behavior of the ram cannot be discounted however as a factor in reproductive efficiency of the ram as 12-13% of potential breeding rams selected in season failed to service estrous ewes in rigorous serving capacity tests. Studies are continuing to evolve in the areas of semen and behavioral testing.

Project 6.

CONTROLLED LIGHT VERSUS MELATONIN EFFECTS ON SEASONALITY OF BREEDING IN RAMS

Personnel: J.A. Fitzgerald, J.N. Stellflug and J. Mole

Objective: Determine the influence of photoperiod and melatonin treated rams on reproductive performance of mature Polypay ewes given melatonin for 40d prior to breeding in late March to April 1987.

Experimental design: Fifteen rams of the Polypay breed were used to test the effect of melatonin supplements in rams in a controlled environment. The rams were trained to serve an artificial vagina (AV) and were incorporated into the ongoing study of fertility testing. Treatment group 1 was comprised of 5 rams on the standard 16 week periods of long and short days. The photoperiod was initiated such that a peak reproductive performance would occur coincident to the spring breeding project. Rams in groups 2 and 3 were used to test whether the supplementation of melatonin at the nadir of the cycle in the winter of 1986 could be used to also bring rams to peak performance. For group 2, rams received implants of melatonin at the nadir of the cycle under long days. The implants were administered for an 8 week period. A 4 week period on long days was followed by 8 weeks of melatonin. Group 3 was similar to group 2 differing only in the duration of the melatonin supplement. Group 3 were treated with melatonin for a 4 week on 4 week off schedule. The off period would correspond to 4 weeks of long days. Ten day implants were used and implanted at weekly intervals. From March 24 to April 27, the rams were joined with melatonin-treated ewes.

Results: Scrotal circumference increased ($P<.05$) earlier in rams for group 2 compared with other treatments. Treatment of the ram for an extended period (6 months) maintained scrotal circumference above that of control rams. Number of ewes lambing/ewe present at lambing averaged 87.6, 89.3 and 81.1% for groups 1, 2, and 3, respectively. Number of lambs born/ewe lambing averaged 1.74, 1.71 and 1.72 for groups 1, 2 and 3, respectively. There were no significant differences among the treatment groups. Thus using melatonin in the ram for at least a 6 week period at the nadir of the scrotal cycle can effectively stimulate testicular growth and also improve fertility by 15 to 20%. Melatonin may provide a more practical alternative to ram management for improved reproduction when compared with confinement in light controlled facilities.

B. Prolificacy

Project 1.

EVALUATE METHODS OF GENETICALLY IMPROVING LAMB PRODUCTION

Personnel: S.K. Ercanbrack

Objective: Compare four alternative selection procedures for increasing normal season lamb production per ewe and two alternative mating procedures combined with selection for increasing lamb production.

Experimental design: Lines of 140 ewes are being selected to improve litter weight at weaning (120 d) on the basis of (1) overall merit plus dam's litter weight (rams) and own litter weight (ewes), (2) litter weight only (of ram's dam and ewe's own), (3) testes size at 120 d (rams) and litter weight (ewes) or (4) body weight at 15 m (rams) and 17 m (ewes). Also, two lines each of 72 inter se mated 1/4 and 1/2 Finncross ewes, respectively, are being compared with appropriate contemporary 1st generation crosses, all selected on litter weight as in (2) above, to evaluate the potential for overcoming recombination loss through selection for additive genetic improvement.

Results: Genetic trends from 1977 through 1987 in 9 purebred lines being selected in various ways for increased lamb production

TABLE 1. REGRESSIONS ON YEARS OF PERCENT SUPERIORITY OVER RANDOM-BRED CONTROLS FOR THREE REPRODUCTION TRAITS OF VARIOUS SELECTION LINES

Line	Selection criteria	Prolificacy	Number weaned	Weight weaned
RAMBOUILLET				
11	Lamb Production	0.9±0.4	1.7±0.8	1.8±0.8
13	Early Puberty	0.1±0.4	-0.4±0.8	-0.1±0.7
TARGHEE				
40	Index + Lamb Production	0.8±0.5	1.0±0.8	0.4±0.9
41	Lamb Production	1.5±0.2	2.1±1.0	1.9±1.0
43	Efficiency of Gain	-0.1±0.8	-0.9±0.8	-0.5±0.9
COLUMBIA				
60	Index + Lamb Production	1.3±0.6	2.0±1.0	2.7±1.3
61	Lamb Production	1.0±0.5	2.0±0.7	2.7±1.1
63	Mature Body Weight	0.8±0.5	1.2±0.4	2.0±0.6
POLYPAY				
70	Index + Lamb Production	-0.1±0.5	0.8±1.0	1.2±1.1
71	Lamb Production	-0.0±0.6	0.5±1.0	1.0±1.4

Above results are based on gains from 1977 through 1987, a period equivalent to about 3.2 generations of selection. The lamb-production selection criterion was weight-weaned-per-ewe-exposed-to-breeding. The index was for overall own merit weighted heavily for body weight.

indicate that percent superiority over unselected controls is increasing annually from -.1 to 1.5 for prolificacy (negative in 2 lines), from -.4 to 2.1 for number weaned (120 d) per ewe exposed and from -.1 to 2.7 for total wt weaned. Standard errors for these regressions presently average 0.5 for prolificacy, 0.8 for number weaned and 1.0 for wt weaned. Standard errors generally are declining about 0.1 per year. The regressions currently translate into annual increases of up to 2.3 percentage points for prolificacy and percent (number) weaned and up to 2.0 lb (0.89 kg) for wt weaned.

Studies also are underway to determine if recombination loss in reproductive merit of inter se mated 1/2 and 1/4 Finncrosses can be recovered within a reasonable time by selection. After 5 years of intensive selection, ratios of inter se mated vs first generation crosses range from 0.94 to 1.10 for prolificacy, 0.88 to 1.04 for number weaned and 0.90 to 1.03 for wt weaned. Ratios continued to be higher for 1/4 Finncrosses. In eight of twelve comparisons, ratios were higher in 1987 than in 1986; more important, half of the 1987 ratios exceeded 1.0 (in 1986 only 1 of 12 ratios exceeded 1.0). Linear regressions on 6 years (ranging from .01 to -.03) indicate that ratios generally are still slowly declining, but current data suggest that perhaps in some instances the decline has stopped.

TABLE 2. RATIOS (BY YEARS) OF INTER SE MATED TO FIRST CROSS PERFORMANCE FOR THREE REPRODUCTIVE TRAITS OF FINN-RAMBOUILLET, -TARGHEE AND -COLUMBIA EWES.

Breed	YEAR							Regr. on
group	1981	1982	1983	1984	1985	1986	1987	yr, %
				Prolificacy				
1/2F1/2R	.985	.914	.948	.890	.962	.914	.937	-0.5±0.6
1/2F1/2T	1.176	1.042	1.079	1.094	.886	.992	1.020	-2.7±1.4
1/4F3/4T	.940	1.049	1.046	.963	1.000	.905	1.101	0.5±1.4
1/4F3/4C	----	.989	.980	1.048	.966	1.080	.995	0.7±1.1
				Net reproduction rate (120 d)				
1/2F1/2R	.957	.922	1.000	.863	.935	.951	.875	-0.9±0.9
1/2F1/2T	1.090	.987	.923	.890	.859	.863	1.017	-1.9±1.6
1/4F3/4T	1.135	.936	1.007	.893	.994	.833	1.038	-1.8±1.9
1/4F3/4C	----	1.034	.927	1.095	1.039	.987	.951	-0.8±1.6
				Litter weight (120 d)				
1/2F1/2R	.947	.925	.971	.905	.883	.930	.896	-0.8±0.5
1/2F1/2T	1.123	.999	.936	.880	.878	.886	1.022	-2.1±1.7
1/4F3/4T	1.111	.921	.989	.887	.988	.881	1.033	-1.1±1.7
1/4F3/4C	----	.999	.927	1.112	1.027	.939	.950	-0.8±1.8

Note: The regression is the annual change in percent relative merit of the inter se groups. Prolificacy is on a per-ewe-lambing basis and net reproduction rate (number weaned) and litter weight are on a per-ewe-exposed basis.

OBJECTIVE 2: Develop feeding strategies for high-producing sheep.

A. Nutrient Requirements and B. Forage Systems

Projects 1, 2, 3, 4.

RANGE NUTRITION AND MANAGEMENT TO IMPROVE PRODUCTIVE EFFICIENCY OF RANGE SHEEP

Personnel: H.A. Glimp

Objective: (1) Provide a better understanding of foraging vectors and preferences and plant effects on animal production and animal effects on plant production, within selected ecosystems and grazing management systems. (2) Evaluate the nutrient needs for optimum production within various ecosystems of ewes gestating and lactating more than one lamb, ewe lambs to be mated at 7 months of age, and market lambs for optimum lean tissue growth.

Experimental design: The following experiments are in the planning stages: (1) Short duration vs conventional grazing systems on unimproved and improved irrigated mountain meadows. Rambouillet, Columbia, Targhee, Polypay and 1/2 Finn ewes and their lambs will be used in this study. Both forage and animal response will be measured. (2) Short duration vs continuous grazing systems with sheep, cattle, or dual grazing of sheep and cattle on sagebrush range. Rambouillet, Columbia and Targhee ewes and their lambs will be used in this study. Plant and animal response will be monitored. (3) The effect of presence or absence of early training (learning) for range foraging on subsequent foraging ability, growth and reproductive performance of ewes. Ewe lambs from three management systems are involved in this study: 1) grazed with their dams from birth to weaning on fall range; 2) grazed with their dams from birth to weaning on alfalfa; 3) no grazing (confinement reared with dams) from birth to approximately 8 months of age. (4) The effect of season, breed and levels of nutrition during lactation on amount and composition of milk produced, ewe weight, lamb growth and subsequent ewe reproductive performance. Rambouillet and Polypay ewes lambing in April and August and nursing twins will be fed at 4 energy intake levels ranging from ad libitum to 80% of NRC. Ewes and their lambs will be fed in individual pens.

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Mole and Fitzgerald. 1987. Three measures of ram sperm function under differing light regimens. Biol. Reprod. 36:24 (Suppl) (Abstract)

Stellflug, J.N., J.A. Fitzgerald and C.F. Parker. 1987. Improve spring breeding of ewes and ewe lambs with melatonin or extended light and melatonin. J. Anim. Sci. 65:392. (Suppl. 1) Abstract.

USDA, ARS JORNADA EXPERIMENTAL RANGE
1988 NC-111 Annual Report

C. V. Hulet

Objective 1. Develop methods for utilization of genetic variation among and within breeds.

A. Select for aseasonality in Polypay and Rambouillet sheep.

Polypay sheep originating in Dubois, Idaho and Rambouillet sheep from Idaho, New Mexico, and Texas are being selected for fertility and fecundity when exposed to rams from about May 20 to July 10 each year.

Preliminary reproduction for the first two lambings are shown in tables 1 and 2. The final selection lines were formed after an initial screening following the first lambing.

The data appear to demonstrate large variation in fertility among sires and between years and suggest that it is very important to select sires on libido and traits associated with offseason fertility such as testes size, minimum variation in testes size over time and high quality semen especially minimal abnormal cells and an absence of white cells.

Table 1. Lambing Response of Rambouillet and Polypay Sheep to May-June Breeding[1]

Age	Year	Breed	Sire Line					Total
			A	B	C	D	E	
Mature	1986	Rambouillet	51	69	55	49		56
		Polypay	74	70	65	62	61	66
	1987	Rambouillet	64	50	76	38		58
		Polypay	48	77	53	30		52
Yearling[2]	1986	Rambouillet	57	50	30	14		34
		Polypay	38	27	5	24		19
	1987	Rambouillet	33	40	83	11		28
		Polypay	33	58	38	29		39

[1]Percent ewes lambing.
[2]Approximate $\leq$ 18 months of age.

Table 2. Lambing Percent of Rambouillet and Polypay Ewes Exposed to Rams in May-June[1]

Age	Year	Breed	Sire Line					Total
			A	B	C	D	E	
Mature	1986	Rambouillet	65	85	68	57		69
		Polypay	126	130	96	95	87	106
	1987	Rambouillet	116	73	92	62		74
		Polypay	61	114	105	60		85
Yearling[2]	1986	Rambouillet	71	50	30	29		44
		Polypay	57	32	10	33	0	27
	1987	Rambouillet	50	40	83	11		31
		Polypay	40	83	77	57		63

[1]Percent lambs born of ewes exposed.
[2]Approximate $\leq$ 18 months of age.

ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER
1988 Station Report to NC-111

Comparison of Finnsheep and Booroola Merino CWU 5438-31000-006
(L. D. Young and G. E. Dickerson)

Objectives are: 1) Compare Booroola Merino and Finnsheep average gene effects on lamb survival, growth and carcass traits and on ewe reproduction and wool production; 2) Estimate level of performance of a cross of Booroola rams on Finnsheep ewes; 3) Compare potential for backcross selection of Booroola and Finnsheep prolificacy genes into an unrelated population; 4) Estimate effect of Booroola prolificacy gene in 1/4, 1/2, and 3/4 Finnsheep; and 5) Explore differences between Booroola and Finnsheep in physiological control of ovulation rate.

Booroola Merino and Finnsheep rams were mated to Finnsheep ewes and C3 ewes (1/2 Columbia, 1/4 Suffolk, 1/4 Hampshire) for 35 days beginning in mid-December of 1983, 1984, 1985 and 1986. Ewes were managed as one group. Lambs were born and raised in a facility with an elevated, woven-wire floor. Lambs were weighed at birth and at an average of 63 (weaning) and 147 days of age. Rams not needed as replacements were slaughtered in groups of approximately 60 after reaching 45.5 kg live weight, and carcass data were recorded. All healthy ewe lambs were moved to outside dirtlots and monitored for age at first estrus by exposure to vasectomized rams beginning at 21 weeks of age. At approximately 7 months of age, all sound, healthy ewe lambs were exposed to fertile rams for 35 days. Breeding marks were recorded three times a week prior to breeding and daily during breeding. Ovulation rate was evaluated by laparoscopic examination 7 to 10 days after the first mating of each ewe lamb to a fertile ram. Embryo survival (number of lambs born per egg ovulated) was measured in first-cross and purebred Finnsheep ewes born in 1984, 1985 and 1986 that were bred to lamb at one year of age. The data on embryo survival included all ewes that had a recorded ovulation rate whether they lambed or not. In 12 of the 360 observations, the recorded ovulation rate was less than the number of lambs born and ovulation rate was set equal to number born. Fleece weight was recorded at shearing one month prior to lambing at 2 years of age for ewes born in 1984, 1985, and 1986.

First-cross and contemporary purebred Finnsheep ewes were evaluated for reproduction through three years of age. The first-cross Booroola-C3 and Finnsheep-C3 ewes were mated to C3 rams to compare the ewe genotypes for reproduction. Finnsheep ewes were mated to Booroola and Finnsheep rams. The first-cross Booroola-Finnsheep ewes were mated to Booroola, Finnsheep and Booroola-Finnsheep rams. The main purpose of these matings was to produce ewes varying in Finnsheep breeding and frequency of the Booroola fecundity gene to determine the effect of the Booroola fecundity gene in a more prolific genetic background. Individual and maternal heterosis effects are included in performance of reciprocal backcrosses and F_2 matings but not in the performance of purebred Finnsheep. Despite this complication, the comparison of the average performance of Finnsheep ewes relative to the average performance of Booroola-Finnsheep ewes is included because it is of biological interest.

Data were analyzed by least-squares procedures utilizing various fixed models. Reproductive data of Finnsheep and C3 ewes mated to Booroola and Finnsheep rams were analyzed with a model that included the effects of year, sire breed, dam breed, age of ewe, sire breed x dam breed, and age of ewe x dam breed. Age of ewe was considered as a fixed effect of ewes lambing at 1, 2, 3, 4, and 5 or more years of age. The linear effect of age and its interaction with sire breed, dam breed and sire breed x dam breed were added to the basic model for analysis of lamb weights at birth, weaning (63 days of age) and 147 days of age. Slaughter weight and its interaction with sire breed, dam breed and sire breed x dam breed were added to the basic model for analysis of carcass weight. Carcass weight and its interaction with sire breed, dam breed and sire breed x dam breed were added to the basic model for the analysis of 12th rib fat thickness and estimated percentage kidney fat. Puberty traits, ovulation rate at first breeding and fleece weight at 2 years of age were analyzed with the basic model.

The model to analyze embryo survival included the effects of year and mating type. There were seven mating types: C3 rams mated to Booroola-C3 and Finnsheep-C3 ewes, Finnsheep rams mated to Finnsheep and Booroola-Finnsheep ewes, Booroola rams mated to Finnsheep and Booroola-Finnsheep ewes and Booroola-Finnsheep rams mated to Booroola-Finnsheep ewes. Conception rate and litter size of first-cross and purebred Finnsheep ewes was analyzed with a model that included the effects of year, parity (1, 2, 3), mating type and the interaction of parity and mating type. Linear combinations of the least-squares means were made to estimate the average performance of Finnsheep ewes (mated to Booroola and Finnsheep rams) and Booroola-Finnsheep ewes (mated to Booroola, Finnsheep and Booroola-Finnsheep rams). In general, the effect of ram breed within ewe breed was not large or significant for the traits evaluated. Thus, the performance of Finnsheep and Booroola-Finnsheep ewes averaged across breed of sire appeared to be the best overall estimate of the performance of these ewe genotypes.

Least-squares means for conception rate, litter size at birth and weaning and lamb mortality to weaning for Finnsheep and C3 ewes mated to Finnsheep and Booroola Merino rams are presented in table 1. There was a significant interaction between sire breed and dam breed for conception rate. Booroola Merino rams had a higher conception rate than Finnsheep rams when mated to Finnsheep ewes but a slightly lower conception rate when mated to C3 ewes. Breed of ram was not significant when averaged over breed of ewe. Finnsheep ewes had a higher conception rate than C3 ewes for both breeds of ram but this difference was larger for Booroola rams (11.0%) than for Finnsheep rams (1.4%). The main effect of sire breed and the interaction of sire breed and dam breed were not significant for litter size at birth, litter size at weaning or lamb mortality from birth to weaning. Finnsheep ewes had larger litters at birth and weaning than C3 ewes. Lamb mortality was also higher in litters from Finnsheep dams than in litters from C3 dams likely reflecting the expected increase in mortality with an increases in litter size at birth.

Least-squares means for individual lamb weights at birth, 63 days of age (weaning) and 147 days of age are presented in table 2. The main effect of sire breed and the interaction of sire breed and dam breed were not significant for birth weight. Lambs from Finnsheep dams were significantly lighter at birth than lambs from C3 dams. However, at weaning and 147 days of age the

interaction of sire breed and dam breed was significant. Lambs sired by Finnsheep rams were significantly heavier at weaning and at 147 days of age than lambs sired by Booroola rams regardless of breed of dam. However, the difference between ram breeds was larger in progeny from C3 dams (4.3 kg at 147 days of age) than those from Finnsheep dams (1.7 kg at 147 days of age).

Least-squares means for carcass traits are shown in table 3. The interaction of sire breed and dam breed was not significant for carcass weight at a constant slaughter weight of 48.3 kg, or for 12th rib fat thickness and estimated percentage kidney fat at a constant carcass weight of 25.4 kg. Finnsheep-sired rams had a larger carcass weight and less 12th rib fat thickness than did Booroola-sired rams, however the difference in estimated percentage kidney fat was not significant. Ram lambs from Finnsheep ewes had smaller carcasses, less 12th rib fat thickness and a higher estimated percentage kidney fat than ram lambs from C3 ewes.

Least-squares breed group means for fleece weight of 2-year-old ewes are also shown in table 3. The interaction of breed of sire and breed of dam was significant for fleece weight. Ewes sired by Booroola rams produced heavier fleeces than did ewes sired by Finnsheep rams regardless of breed of dam. However, relative to fleeces from Finnsheep-sired ewes, fleeces from Booroola-sired ewes were 1.1 kg heavier from ewes out of Finnsheep dams and only .7 kg heavier from ewes out of C3 dams.

Least-squares means for puberty traits and ovulation rate of ewe lambs are presented in table 4. There was a significant sire breed x dam breed interaction for percentage of ewe lambs that reached puberty by the end of the first breeding season. Approximately 94% of the ewes sired by Finnsheep rams reached puberty regardless of the breed of dam. However, only 60% of the Booroola-sired ewe lambs out of C3 dams reached puberty while 93% of those out of Finnsheep dams reached puberty. Only the effect of sire breed was significant for age at puberty. Of the ewe lambs that showed puberty, Finnsheep-sired ewe lambs were almost 9 days younger at puberty than Booroola-sired ewe lambs. Ovulation rate of ewe lambs that mated during their first breeding season was higher for lambs from Booroola sires than those from Finnsheep sires and higher for lambs from Finnsheep dams than those from C3 dams. One copy of the Booroola fertility gene increased ovulation rate of ewe lambs by .35 more eggs than did a sample half of the Finnsheep prolificacy genes.

Despite fairly large differences, the effect of mating type on embryo survival was not significant. The least-squares means, standard errors and number of observations were: 81.1 ± 4.2, 99; 73.8 ± 3.9, 120; 84.5 ± 4.4, 94; and 66.7 ± 6.2, 47 and for Finnsheep, Booroola-Finnsheep, Finnsheep-C3 and Booroola-C3 ewes, respectively. Although the differences were not statistically significant, the ewes sired by Booroola rams had lower embryo survival rates than did ewes sired by Finnsheep rams.

The distribution of number of Finnsheep, Booroola-Finnsheep, Finnsheep-C3 and Booroola-C3 by parity are shown in table 5. There are more data on first parity than second parity and even less on third parity because ewes born in 1984, 1985 and 1986 contribute to first parity; ewes born in 1984 and 1985 contribute to secondparity and only ewes born in 1984 contribute to third

parity. Analysis of conception rate of ewes lambing at 1, 2 and 3 years of age showed a significant interaction of mating type and parity. The least-squares means for conception rate by breed of ewe and parity are shown in table 5. The cause of the significant mating type by parity interaction is the exceptionally low conception rate of Booroola-C3 ewe lambs bred to lamb at one year of age which is a reflection of the low percentage reaching puberty in this genotype. The differences between mating types in subsequent parities were not significantly different. Conception rate at third parity for Finnsheep ewes was relatively low (based on only 9 ewes) but not significantly lower than for the other breed groups.

The interaction of mating type and parity was significant for number of lambs born and number of lambs weaned but not for mortality. The least-squares means for number born by breed of ewe and parity are shown in table 6. The main cause of this significant interaction is the relatively small increase in litter size at birth with an increase in parity expressed in Finnsheep-C3 ewes relative to the other genotypes. The increase from first to second parity is also larger in Booroola-Finnsheep and Booroola-C3 ewes than in Finnsheep ewes. The least-squares means for number weaned are presented in table 7. The main causes of this significant interaction are a larger increase from first to second parity in Booroola-C3 ewes than in Finnsheep-C3 ewes and a larger increase from second to third parity in Booroola-Finnsheep ewes than for any of the other genotypes. It should be remembered that there is relatively little data on third parity females and it represents ewes from only one birth year. Least-squares means and standard errors for mortality were 25.0±3.6%, 9.1±4.6%, 20.9±3.1% and 19.9±2.5% for Booroola-C3, Finnsheep-C3, Booroola-Finnsheep and Finnsheep ewes,respectively. Clearly, Finnsheep-C3 ewes had less mortality which likely results from their lower overall litter size at birth.

Based on the results presented here, the Booroola Merino seems less desirable than the Finnsheep for increasing reproduction. The Booroola Merino grows slower than the Finnsheep which is already criticized for its slow growth. More importantly the Booroola Merino is slow to reach puberty and only approximately 40% of crossbred ewes lambed at one year of age. This is a major economical disadvantage which is not easily offset by the increased wool production at current U.S. wool prices. An unexpected concern is that ewes that are heterozygous for the Booroola fecundity gene may be too prolific at second or later parities. Many producers feel that 1/2 Finnsheep ewes are too prolific but the Booroola-C3 ewes had larger litters at birth than Finnsheep-C3 ewes. However, since mortality was nearly 3 times as high in litters from Booroola-C3 ewes as that in Finnsheep-C3 ewes, they each had about the same number of lambs at weaning.

Adaptability of Four Breeds to Three Six-Month Breeding Schedules
CWU 5438-31000-006 (L. D. Young and G. E. Dickerson)

The general objectives are (1) to evaluate adaptability of Dorset, Finnsheep, Composite I (1/2 F, 1/4R, 1/4D), and Composite II (1/2F, 1/4S, 1/4T) populations to three six-month breeding schedules, (2) evaluate between and within breed genetic variation in seasonal estrous, and (3) evaluate between and within breed genetic variation in estrous during lactation.

Ultimately, 100 ewes of each breed will be assigned to each of the following six-month breeding schedules.

Group	Spring breeding	Fall breeding
1	February 5 to March 8	August 13 to September 12
2	March 13 to April 12	September 18 to October 17
3	April 17 to May 17	October 22 to November 21

This experiment was initiated in the fall of 1984 with dry ewes. The Composite I and Composite II have reached the 100 ewe limit in all groups because there were more of these available initially. Ewe lambs have been added to these breeds to keep them comparable to the Dorset and Finnsheep in in distribution of age of ewe. All lactating and non-lactating ewes are exposed to fertile rams of their own breed at each assigned period in single sire pens. Lambs are not weaned until the end of the breeding season.

Data from 1985, 1986 and 1987 birth years was presented in last years annual report. Data from 1988 birth year has not been analyzed so additional data summaries will not be presented this year.

Genetic effects on efficient production of protein in sheep
CWU 5438-31000-007 (K. A. Leymaster, T. G. Jenkins and G. E. Dickerson)

The primary objectives are to: 1) Evaluate genetic differences among terminal sire breeds for developmental growth and fitness traits; 2) Investigate novel approaches to predict carcass composition from live animal and carcass traits; and 3) Estimate genetic and phenotypic parameters involving growth rate, feed intake and carcass composition so that selection criteria can be established to improve lean growth efficiency and lean content.

The contemporary production of 2-, 3-, and 4-year-old Suffolk and Composite III ewes was reported last year. The Composite III population was formed in 1980 to provide a heterogeneous, straightbreeding experimental flock characterized by rapid growth and large mature size. The flock is used to provide animals for research on lean growth efficiency. The population was formed by crossing Columbia rams on Suffolk-Hampshire crossbred ewes. At least 27 rams have been used during each of the first four generations. The Suffolk and Composite III flocks have been unselected and randomly mated.

Results of ewes bred to lamb at 1 year of age are given in table 8. The production levels shown were adversely affected by the severe blizzard that occurred in late March of 1987. Suffolk ewes were 1.9 kg heavier at breeding ($P<.05$), but conception rates were equivalent for the two breeds. Composite III ewes were less prolific, however, their lambs survived at a greater rate to weaning. Consequently, the number of lambs weaned per ewe lambing was similar. Composite III lambs were heavier at birth ($P<.01$), had greater preweaning daily gains ($P<.10$), and were heavier at weaning ($P<.10$). The net productivity trait, litter weaning weight per ewe exposed, indicated a nonsignificant 9% advantage for Composite III sheep. These results are generally consistent with differences between 2-, 3-, and 4-year-old Suffolk and Composite III ewes reported last year. The data are interpreted to indicate that the composite population performed at least as well as the best contributing pure breed.

The Texel flock has started the fourth year of a five-year quarantine period. During November and December of 1987, 62 Texel ewes were synchronized and single-sire mated to five Texel rams. Two ewes died prior to the lambing season. Of the remaining ewes, 56 lambed and produced 77 Texel lambs. The flock presently has 92 ewes and 77 rams. Frozen Texel semen was imported from New Zealand in 1987 in an attempt to broaden sampling of the breed. Unfortunately, the semen was thawed upon arrival. We are presently making arrangements to import semen for use during the 1988 breeding season.

An experiment to estimate the direct genic effects of Texels and Suffolks on developmental growth traits was started in 1987. Mature Composite I ewes (86) were synchronized and mated to ten Suffolk and nine Texel rams. Multiple-born, multiple-reared lambs (ewes and wethers) will be serially slaughtered at 9, 15, 21, and 27 weeks of age. The response variables of primary interest are accretive rates of carcass protein and fat based on chemical analysis. At nine weeks of age, there was no difference in live weight of Suffolk- and Texel-sired lambs, 43.5 and 42.9 pounds, respectively. The experiment will be repeated in 1989.

Research continued on methods to estimate carcass composition. Feeding behavior traits were measured on 176 Composite III rams. Following slaughter, resistive impedance was measured on warm and chilled carcasses. The carcasses were chemically analyzed and the relationships of composition with feeding behavior traits and resistive impedance will be determined. These data will also contribute to a larger data set designed to allow estimation of heritabilities and genetic correlations involving growth rate, feed intake and carcass composition. Such data have been collected on about 11 sons from each of 30 sires. The reproductive performance of half-sib sisters, 20 per sire, has been recorded to investigate the genetic relationships of component traits of lean growth efficiency with various reproductive traits.

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Young, L. D. and G. E. Dickerson. 1987. Importation of Romanov sheep. Sheep Research Program Progress Report No. 3, USDA ARS-68, pp. 8.

Table 1. Least-squares means and significance levels for reproductive traits of C3 and Finnsheep ewes mated to Booroola and Finnsheep rams

Sire breed	Dam breed	Conception rate, % No.	Conception rate, % Mean	No. litters	No. born	No. weaned	Percent mortality
Finn	Finn	294	77.0	226	2.60	1.83	26.6
Boor	Finn	360	83.8	308	2.52	1.83	24.8
Finn	C3	315	75.6	240	1.61	1.51	5.8
Boor	C3	340	72.8	251	1.57	1.39	10.9
Range of S.E.[a]			2.4-2.9		.04-.05	.05-.06	1.9-2.3
Model effect[b]							
Sire breed			n.s.		n.s.	n.s.	n.s.
Dam breed			.03		.0001	.0001	.0001
Sire breed x Dam breed			.04		n.s.	n.s.	.06

[a]S.E. is standard error.

[b]Level of significance for the model effect. n.s. is not significant, P>.05.

Table 2. Least-squares means and significance levels for weight at birth, 63 days (weaning) and 147 days of age of lambs produced from mating C3 and Finnsheep ewes to Booroola and Finnsheep rams

Sire breed	Dam breed	Birth wt, kg		63-day wt, kg		147-day wt, kg	
		No.	Mean	No.	Mean	No.	Mean
Finn	Finn	574	2.87	417	16.9	385	33.3
Boor	Finn	743	2.89	559	15.2	526	31.6
Finn	C3	399	5.17	370	23.5	345	43.4
Boor	C3	412	5.21	343	20.5	342	39.1
Range of S.E.[a]			.04		.2-.3		.4
Model effect[b]							
Sire breed			n.s.		.0001		.0001
Dam breed			.0001		.0001		.0001
Sire breed x Dam breed			n.s.		.008		.0004

[a]S.E. is standard error.

[b]Level of significance for the model effect. n.s. is not significant, P>.05.

Table 3. Least-squares means and significance levels for carcass traits of ram lambs and fleece weight of 2-year-old ewes produced from mating C3 and Finnsheep ewes to Booroola and Finnsheep rams

		Carcass traits				Fleece wt, kg	
Sire breed	Dam breed	No.	Carcass wt, kg[a]	12th rib fat depth, cm[b]	Est. kidney fat, %[b]	No.	Mean
Finn	Finn	102	25.6	.238	2.53	106	2.1
Boor	Finn	182	25.0	.328	2.57	138	3.2
Finn	C3	169	26.1	.310	2.14	113	3.2
Boor	C3	163	25.2	.375	2.18	104	3.9
Range of S.E.[c]			.1	.009-.012	.05-.07		.1
Model effect[d]							
Sire breed			.0001	.0001	n.s.		.0001
Dam breed			.034	.0001	.0001		.0001
Sire breed x Dam breed			n.s.	n.s.	n.s.		.014

[a]Adjusted to mean live weight of 48.3 kg.

[b]Adjusted to mean carcass weight of 25.4 kg.

[c]S.E. is standard error.

[d]Level of significance for the model effect. n.s. is not significant, P>.05.

Table 4. Least-squares means and significance levels for puberty traits and ovulation rate of ewe lambs produced from mating C3 and Finnsheep ewes to Booroola and Finnsheep rams

Sire breed	Dam breed	% Pubertal		Puberty age, d		Ovulation rate	
		No.	Mean	No.	Mean	No.	Mean
Finn	Finn	191	94.6	181	183.1	135	2.12
Boor	Finn	229	93.3	210	189.4	183	2.56
Finn	C3	177	94.2	163	179.6	148	1.62
Boor	C3	158	60.3	94	190.6	69	1.89
Range of S.E.[a]			2.1-2.5		1.4-2.1		.05-.08
<u>Model effects</u>[b]							
Sire breed			.0001		.0001		.0001
Dam breed			.0001		n.s.		.0001
Sire breed x Dam breed			.0001		n.s.		n.s.

[a]S.E. is standard error.

[b]Level of significance for the model effect. n.s. is not significant, P>.05.

Table 5. Least-squares means and standard errors for conception rate by breed of ewe and parity

	No. obs. by parity			Mean Conception rate by parity		
Ewe breed	1	2	3	1	2	3
Finnsheep[a]	153	87	44	78.2±3.0	92.9±4.2	99.1±5.9
Booroola-Finnsheep[b]	151	87	24	75.6±3.0	97.0±4.1	103.8±7.8
Finnsheep-C3	114	64	9	78.0±63.5	91.6±4.8	81.5±12.4
Booroola-C3	117	67	23	39.4±3.4	95.7±4.6	95.1±7.9

[a]Average performance when mated to Finnsheep and Booroola rams.

[b]Average performance when mated to Finnsheep, Booroola and Booroola-Finnsheep rams.

Table 6. Least-squares means and standard errors for number of lambs born by breed of ewe and parity

	No. obs. by parity			Mean litter size at birth by parity		
Ewe breed	1	2	3	1	2	3
Finnsheep[a]	118	78	41	1.95±.07	2.55±.09	3.03±.13
Booroola-Finnsheep[b]	108	73	21	1.96±.07	2.81±.09	3.44±.17
Finnsheep-C3	90	58	7	1.52±.08	1.86±.10	1.95±.28
Booroola-C3	42	57	17	1.39±.12	2.20±.10	2.66±.28

[a]Average performance when mated to Finnsheep and Booroola rams.

[b]Average performance when mated to Finnsheep, Booroola and Booroola-Finnsheep rams.

Table 7. Least-squares means and standard errors for number of lambs weaned by breed of ewe and parity

	Mean litter size at weaning by parity		
Ewe breed	1	2	3
Finnsheep[a]	1.43 ± .08	2.09 ± .10	2.47 ± .13
Booroola-Finnsheep[b]	1.38 ± .08	2.08 ± .10	2.81 ± .18
Finnsheep-C3	1.18 ± .09	1.73 ± .11	2.00 ± .30
Booroola-C3	.93 ± .12	1.74 ± .11	2.00 ± .20

[a]Average performance when mated to Finnsheep and Booroola rams.

[b]Average performance when mated to Finnsheep, Booroola and Booroola-Finnsheep rams.

Table 8. Least-squares means and standard errors of Suffolk and Composite III flocks for traits measured to weaning at 7 weeks of age[a]

Trait	Level of significance	Suffolk	Composite III[b]
Number of ewes exposed[c]		163	235
Weight at breeding, kg	*	48.3 ± .5	46.4 ± .4
Conception rate, %	NS	56.6 ± 3.8	56.6 ± 3.2
Number born per ewe lambing	NS	1.19 ± .04	1.12 ± .03
Birth weight, kg			
Per lamb	**	4.76 ± .11	5.20 ± .10
Per ewe lambing	NS	5.64 ± .16	5.78 ± .13
Preweaning survival, %	NS	50.9 ± 4.7	55.0 ± 4.1
Preweaning daily gain, g/d	†	239 ± 10	262 ± 9
Number weaned per ewe lambing	NS	.60 ± .06	.62 ± .05
Weaning weight, kg			
Per lamb weaned	†	16.5 ± .6	17.8 ± .5
Per ewe lambing	NS	10.1 ± 1.0	11.3 ± .9
Per ewe exposed	NS	6.0 ± .7	6.5 ± .6

[a]The statistical model included the effects of season and breed. Weaning age was included as a covariate for weaning wt per lamb.

[b]One-half Columbia, one-quarter Suffolk and one-quarter Hampshire germ plasm.

[c]All ewes were 6 to 7 months of age at breeding.

UTAH STATE UNIVERSITY
1988 ANNUAL REPORT TO NC-111
INCREASED EFFICIENCY OF SHEEP PRODUCTION

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Objective 1: Develop methods for utilization of genetic variation among and within breeds.

A. Genetic influences on puberal events and response to hormone treatment.

Table 1 summarizes information on events related to puberty; and to response to hormone treatment in Rambouillet, Suffolk and St. Croix ewes.

During the observation period 89% of the St. Croix ewes reached puberty (demonstrated estrus) at 185.2 days of age and 32.1 kg body weight compared to 47%, 241 days, and 50.7 kg for Rambouillet ewes and 64%, 234 days, and 55.9 kg for Suffolk ewes, respectively. These results demonstrate that the St. Croix ewe lambs reach puberty at a younger age and body weight than the Rambouillet or Suffolk.

The number of ovarian cycles (ovulation periods) prior to ovulation accompanied by estrus was 0.7 for the St. Croix and 1.0 for both the Rambouillet and Suffolk. These results indicate the earlier age at puberty in St. Croix occurs due to earlier onset of first ovulation and to the occurrence of less ovarian cycles before the occurrence of estrus.

At the end of the observation period for puberty (November), ewes of the three breeds were subjected to the following hormone treatment; intravaginal sponges containing 40 mg FGA for 14 days with a total of 24 mg equivalents of FSH administered in six injections at 12-hour intervals on day-1, 0 and +1 of sponge removal. The results are shown in table 2. Differences among breeds were found in hours from sponge removal to estrus, superovulation and percent embryos recovered.

This preliminary analysis of the results indicate that breed differences exist in the occurrence of puberty and subsequent response to hormone treatment and embryo collection.

B. Postpartum Events

Events of the postpartum interval were measured during the fall breeding period to avoid confounding with seasonal anestrus. The following genotypes of sheep were used; St. Croix, Rambouillet, White-face (targhee-type) and Black-Face (Suffolk x Targhee-Finnsheep). Data are summarized in tables 2-7. Significant variation occurred among years. The time from parturition to first ovulation was similar among genotypes, within years for all comparisons. Differences in length of the interval from parturition to first estrus was due to the variation in the occurrence of ovulation accompanied by estrus. It is possible that a major factor in determining the length of the postpartum interval among genotypes or individuals within genotypes is their ability to show estrus following initiation of ovulation. Those with the shortest postpartum interval are those in which estrus accompanies first postpartum ovulation. The data reported here also show that the first ovarian cycles before the occurrence of estrus, and in some cases the first estrous cycles, are of reduced length.

There was also evidence that small increases in progesterone levels (.5 ng/ml or less) of short duration (2-3 days) occur within the first 10 days postpartum and may represent ovulation and formation of corpora lutea with very short duration or luteinization of unovulated follicles.

There was no indication of the influence of lactation (mastectomized vs. intact lactating, suckled ewes) or of the level of prolactin (mastectomized and intact ewes, with and without Bromocriptine) on the postpartum occurrence of ovulation or estrus.

Tonic levels of LH (basal level, pulse height) are lowest and LH pulse frequency lowest during the week prepartum and the first two to three weeks postpartum. The levels and pulse frequency increases beginning at about three week postpartum.

Continuing research will focus on the endocrinology of the very early postpartum period and its relationship to ovulation and estrus.

C. Seasonal Influences on Reproduction Parameters.

Selected reproduction traits were measured and compared between the Rambouillet and St. Croix breeds in Utah (41° 46" N 111° 40" W).

Seasonal patterns of occurrence of estrus and ovulation, measured over a two-year period, were practically indentical between both years and breeds (table 8). The breeding season began in August and ended in May (breeding period of nine months and nonbreeding period, seasonal anestrus, of three months. At least in the Rambouillet the incidence of ovulation was greater than of estrus during the transition periods between the breeding and non-breeding periods (April and August). Ovulation rates did not differ statistically between breeds or periods of the year but tended to be higher in the St. Croix and during the height of the breeding period.

Ewes of the St. Croix and Rambouillet breeds were placed on a six-month lambing interval with 40-day breeding periods beginning August 1 and February 1 and a 12-month lambing interval with breeding beginning on November 1. Ewe lambs were exposed for breeding at six months of age. The St. Croix lambed first at one year of age and 13% lambed again at 1.5 years of age and 48% of the ewes three years of age and older lambed at six-month intervals. The Rambouillet lambed first at 18 months of age and 1% of the ewes 36 months of age and older lambed at six-month intervals. The difference between the two breeds was due to differences in length of the postpartum interval. Yearly lambing rates and parturition intervals were affected accordingly.

Preliminary results are available on semen characteristics (semen collected by artificial vagina) and scrotal measurements for the St. Croix and Suffolk breeds. Observations were begun in late March 1988 for the St. Croix which is approximately the transition period from the breeding to the non-breeding season in the St. Croix ewe and early May for the Suffolk (representing the first month of seasonal anestrus in the St. Croix ewe). Five St. Croix rams (four, two and one, five years old) and three Suffolk rams (one year old) were used. Four of the five St. Croix and none of the three Suffolks served the artificial vagina. All of the St. Croix and none of the Suffolk bred ewes that had been subjected to hormone treatment to induce estrus. This suggests that libido maybe be reduced during this period and that the affect may be greater in the Suffolk than the St. Croix. Age of ram may also have had an influence.

No changes occurred during the period of observation in semen characteristics or scrotal measurements for the St. Croix or among scrotal measurements for the Suffolk. The overall mean semen traits for the four St. Croix rams were volume, 1.2 ml; mobility, 85%; concentration, 2.82×10^9; and total sperm per ejaculate, 3.38×10^9. The scrotal size was measured as volume, circumference, length and palpation score. A high correlation exists among these measures. The testicles of the Suffolk were larger than the St. Croix (volume, 573 vs. 819 ml; and circumference, 30.2 vs 34.3 cm). These measurements will continue for at least twelve-months to allow observation for seasonal affects.

D. Response of the St. Croix to two climatic environments.

Management practices, including source and level of feed, were standardized for groups of St. Croix sheep on the island of St. Croix (17° 43" N 64° 40" W) and in Utah (41° 46" N 111° 40" W). Pelleted feed (80% alfalfa, 20% barley) from Idaho was fed at both locations. A small amount of unchopped grass hay of local origin was fed to provide for proper rumen function. Observations reported here were begun in the summer or fall of 1987.

One group of ewes at each location are being observed daily for the occurrence of estrus using painted teaser rams, and monthly for the occurrence and rate of ovulation, using laparoscopy. Body weights and condition scores were also obtained monthly. Results are summarized in (table 12). Estrus and ovulation occurred in all ewes throughout the period tested in St. Croix (except 84.6% showed estrus in February and April and 84.6% ovulated in January). However, none of the ewes in Utah showed estrus and only 15% ovulated in July. This increased to 69.2% and 76.9%, respectively, in August and continued in practically all ewes until the following April when seasonal anestrus was initiated with 64.3% of the ewes showing estrus and 78.6% ovulating. Ovulation rate, based on ewes ovulating, did not vary during the period of the year measured indicating no seasonal influence on ovulation. The ovulation rate was typically 2.0 or higher each month at both locations. The hours of daylight decreased by only two hours between July and December on St. Croix while daylight decreased by approximately 5.5 hours in Utah during the same time period.

Body weights tended to be heavier and body condition scores tended to be higher in the ewes at Logan.

In another study ewes were bred for approximately 35 days beginning November 1 and body weight, ewe reproduction performance and lamb weights and rates of gain to eight weeks of age were obtained. Collection is not complete for all data. Some data collected at Utah are also presented for the previous year (1986-87). Preliminary tabulation of reproductive parameters appear to vary with age of animal and year but not location (table 13). Fertility varied from 89.3 to 100% and prolificacy from 176 to 220% in ewes two years of age and older and 130% in ewes lambing at one year of age. Birth weight of lamb per ewe (unadjusted for sex or type of birth) varied from 4.1 to 6.3kg. Body weights and condition scores of ewes (table 14) tended to be lower for ewes in St. Croix than in Utah. Body weights reflect stage of pregnancy and loss due to lambing. The higher condition scores may reflect a higher response to a similar level of feed, in Utah than in St. Croix.

Individual lamb body weights (unadjusted for sex and type of birth) and average daily gain are shown in table 15. Body weights appear higher at each two week weigh period for lambs at Utah than St. Croix.

All of the above measurements, plus postweaning body weight, condition score and growth rate of lambs, will continue for a two-year period. Additional information will be collected on age at puberty, endocrine profile, and also seasonal variation of rams. In additiion a group of seven St. Croix and seven Targhee-type ewes in Utah are being subjected to a photoperiod schedule similar to that existing in St. Croix but with other environmental factors unmodified. The occurrence of estrus and ovulation and also endrocrine levels at selected periods will be compared to responses of St. Croix ewes in St. Croix and in Utah exposed to the natural photoperiod.

Table 1. **Events relating to puberty and response to hormonal synchronization of estrus and superovulation by breed**

Breed	No. ewes	Puberty Percent	Puberty Age (days)	Puberty Wt. (kg)	Response to hormone treatment % Showing estrus	Response to hormone treatment Time from sponge removal to estrus (hr.)	Response to hormone treatment Ovulation rate (No. CL)
St. Croix	17	89	185	32.1	100	28	6.12
Rambouillet	15	47	241	50.7	100	40	5.27
Suffolk	16	64	234	55.9	94	32	2.50

Table 1. **Events relating to puberty and response to hormonal synchronization of estrus and superovulation by breed (cont.)**

Breed	Response to hormone treatment % recovery	no. embryos recovered	% embryos recovered[2]	% fertility[3]
St. Croix	58	2.65	43	65
Rambouillet	54	2.87	54	87
Suffolk	50	0.81	33	50

[1]Total number of unfertilized ova plus embryos as proportion of total number CL.

[2]Total number of embryos as a proportion of total number of CL.

[3]Total number of ewes with embryos as a proportion of total number of ewes.

Table 2. Events of the postpartum interval in St. Croix and Rambouillet ewes.[1,2]

	St. Croix	Rambouillet
Number of ewes	17	4
Percent ewes ovulating	100	75
Days to first ovulation	35.8 ± 3.13	35.6 ± 4.26
Days to second ovulation	42.3 ± 5.49	48.0 ± 6.51
Percent ewes showing postpartum estrus	100	0
Days to first estrus	40.2	>70

[1]Observations were made to 70 days postpartum.

[2]Information on time of ovulation determined from serum progesterone levels.

Table 3. Influence of days to first estrus on conception rate in St. Croix ewes

No. of Observations	Days to first estrus	Days to second estrus
29[1]	36.1 ± 2.23	-
18[2]	23.1 ± 1.99	38.36 ± 1.61

[1]Ewes that conceived to breeding at first postpartum estrus.

[2]Ewes that conceived to breeding at second postpartum estrus after failing to become pregnant following breeding at first postpartum estrus.

Table 4. Interval in days (mean and standard error of the mean) between lambing and first postpartum ovulation.[1]

Genotype	Treatment	n	Year 1986	n	1987	Prob.	Combined years
White-Face							
	Intact	3	21.6±2.8[a]	20	13.0±1.1[b,c]	P<.05	17.3
	Mastectomized	3	17.3±2.8[a,b]	4	10.8±1.3[c]	P<.05	14.0
Black-Face							
	Intact	8	19.6±1.7[a]	5	13.2±2.2[b,c]	P<.05	16.4
	Intact + bromocriptine	3	14.6±2.8[a,b,c]		--		--
	Mastectomized	10	16.5±1.5[a,b]	2	11.5±3.5[b,c]	P>.05	14.0
	Mastectomized+ bromocriptine	5	16.8±2.2[a,b]		--		--
St.Croix							
	Intact		--	9	15.8±1.6[a,b]		--

1) P <.05 for the means not bearing the same superscript.

Table 5. Number of ovarian cycles (mean and standard error of the mean) occurring between first ovulation and first estrus.[1]

Genotype	Treatment	n	Year 1986	n	1987	Combined years
White-Face						
	Intact	3	.7±.4	17	.9±.1	.8
	Mastectomized	3	.7±.4	13	.6±.2	.6
Black-Face						
	Intact	7	1.1±.2	5	.8±.3	1.0
	Intact+ bromocriptine	3	.3±.2		-	-
	Mastectomized	10	1.2±.2	2	.0±0	.6
	Mastectomized+ bromocriptine	5	1.±.3		-	-
St.Croix						
	Intact		-	9	.8±.2	-

1) P >.05 for all genotype and treatment means

Table 6. Interval in days (mean and standard error of the mean) from lambing to first ovulation accompanied by estrus.[1]

Genotype	Treatment	n	1986	n	1987	Proba.[1]	Combined years
White-Face							
	Intact	3	40.7±6.1[a]	17	26.4±2.5[b,c,d]	P<.05	33.6
	Mastectomized	3	33.0±6.1[a,b,c]	13	19.6±2.9[c,d]	P<.05	26.3
Black-Face							
	Intact	8	34.5±3.7[a,b]	5	21.8±4.7[c,d]	P<.05	28.2
	Intact+ bromocriptine	3	19.7±6.1[c,d]		-		-
	Mastectomized	10	33.7±3.3[a,b]	2	11.5±7.5[d]	P<.05	22.6
	Mastectomized+ bromocriptine	5	35.2±4.7[a,b]		-		-
St.Croix							
	Intact		-	10	27.2±3.3[a,b,c,d]		-

1) P <.05 for the means not bearing the same superscript. 1) Statistical differences between years.

Table 7. LH patterns in White-Face ewes before lambing and during the postpartum period in 1987 (mean and standard error of the mean in ng/ml).[1]

Bleedings	Treatment	n	LH Basal Conc.	LH Mean Conc.	Amplitude of Pulses	Pulse interval[3)] (hr.)
5-8 days prepartum	Intact	8	.12±.2[a]	.18±.5[a]	.28±.6[a]	8.0
	Mastec.	8	.13±.2[a]	.21±.5[a]	.45±.6[a]	8.0
8-11 days postpartum	Intact	6	.13±.2[a]	.76±.5[a]	2.06±.6[b]	3.2
	Mastec.	8	.52±.2[a]	1.21±.5[a]	1.79±.6[b]	4.0
17-19 days postpartum	Intact	8	.58±.2[a,b]	.93±.5[a]	1.54±.6[a,b]	3.7
	Mastec.	8	.37±.2[a,b]	1.25±.5[a]	1.10±.6[a,b]	3.1
24-26 days postpartum	Intact	8	.95±.2[b]	3.42±.5[b]	4.70±.6[c]	4.5
	Mastec.	8	.72±.2[b]	2.42±.5[b]	4.28±.6[c]	4.0

1) P <.05 for means not bearing the same superscript in the same column.

Table 8. The mean occurrence of estrus and ovulation and ovulation rate in Rambouillet and St. Croix ewes by month (1982 and 1983 combined).

	Rambouillet			St. Croix		
Mo.	Estrus (%)	Ovulation (%)	Ovulation	Estrus (%)	Ovulation (%)	Ovulation rate
Jan	100	95	1.70	100	100	1.74
Feb	75	100	1.40	95	100	1.83
Mar	80	90	1.44	95	95	1.52
Apr	55	55	1.29	74	74	1.56
May	0	0	0	5	5	1.00
Jun	0	0	0	0	0	0
Jul	0	0	0	0	0	0
Aug	35	70	1.47	45	70	1.56
Sep	95	95	1.96	100	100	1.60
Oct	95	100	1.67	100	100	1.92
Nov	100	100	1.83	100	100	2.09
Dec	100	100	1.72	100	100	2.09

Table 9. Percent of ewes lambing at 6 month intervals.

Breed	Age at lambing	No. of observa-tions	No. ewes lambing at 6 mo. interval	Percent of ewes lambing[1]
St. Croix	12 mo.	61	8	13.1
	Mature[2]	108	52	48.1
Average				35.5
Rambouillet	12 mo.[3]	40	0	0
	Mature[2]	85	1	1.2

[1]Percent of ewes lambing at two consecutive six month intervals of the total six month intervals.

[2]36 months of age and older.

[3]Included ewes placed in study at 12 months of age, and replacement ewes placed in the study at six months of age.

Table 10. The percent ewes lambing and lambing rate for St. Croix and Rambouillet ewes bred at 6, 12 and 18 months of age and maintained on a six month lambing interval

Breed	Age at breeding	No. of observations[3]	Ewes lambing[2]	Lambing rate
St. Croix				
	6 months	68	89[a]	1.50±.065
	12 months	48	48[b]	1.52±.108
	18 months	52	90[a]	1.80±.067
Rambouillet[1]				
	12 months	40	0 [d]	0
	18 months	40	75[c]	1.33±.089

[1]Included ewes were placed in the study at 12 months of age and replacement ewes placed in the study at six months of age.

[2]$p<0.05$ for means not having the same superscript letters ($p<0.01$ for a,b,c, vs. d)

[3]The same ewes were represented in more than one age category.

Table 11. Lambing rates and parturition intervals of St. Croix ewes on six-month and 12-month lambing schedules.

	Years	No. lambings	Lambing rate/ lambing	Lambing rate/ewe /years	Parturition interval
A. Six-month interval lambing schedule					
Lambing at six-month interval					
Mature	1978-84	52	1.75±.07	3.50	191.0±1.67
Immature	1978-84	32	1.60±.09	3.20	188.6±1.64
Lambing at twelve month interval					
Mature	1978-84	56	2.03±.07	2.03	349.7±1.44
Immature	1978-84	28	1.61±.09	1.61	355.0±1.38
B. Twelve-month interval lambing schedule					
Mature	1984-86	102	1.84±.05	1.84	358.2± .77
Immature	1984-86	38	1.60±.08	1.60	361.4±1.78

Table 12. Mean seasonal variation in reproductive measurements in St. Croix ewes in St. Croix and in Utah (1987-1988).

Month	No. ewes	Body weight (kg)	Body condition score[2]	Estrus Occurrence (%)	Ovulation Occurrence (%)	Ovulation Rate	Daylight (hr)
ST. CROIX (17°43"N 64°40"W):							
July	15	42.1 ± 1.3[1]	-	100.0	100.0	1.9 ± 0.19	13.02
August	15	41.6 ± 1.5	-	100.0	100.0	2.1 ± 0.15	12.63
September	15	44.0 ± 1.5	4.40 ± 0.23	100.0	100.0	2.1 ± 0.13	12.13
October	15	46.6 ± 1.4	4.52 ± 0.23	100.0	100.0	2.3 ± 0.16	11.65
November	13	45.4 ± 1.4	4.17 ± 0.18	100.0	100.0	2.0 ± 0.16	11.25
December	13	45.3 ± 1.2	4.65 ± 0.16	100.0	100.0	2.1 ± 0.14	11.07
January	13	45.6 ± 1.4	4.00 ± 0.16	100.0	84.6	2.0 ± 0.13	11.67
February	13	45.5 ± 1.6	3.77 ± 0.17	84.6	100.0	1.9 ± 0.18	11.67
March	13	46.0 ± 1.5	4.31 ± 0.21	100.0	100.0	2.0 ± 0.11	12.12
April	13	46.4 ± 1.5	4.08 ± 0.18	84.6	100.0	1.9 ± 0.10	12.63
UTAH (41°46"N 111°50"W):							
July	13	-	-	0	15.4	2.0 ± 0	14.80
August	13	-	-	69.2	76.9	2.0 ± 0.21	13.63
September	12	53.6 ± 2.0	5.06 ± 0.25	100.0	84.6	2.3 ± 0.14	12.75
October	12	55.0 ± 1.9	4.17 ± 0.26	100.0	100.0	2.3 ± 0.18	10.85
November	12	53.5 ± 2.0	5.25 ± 0.31	100.0	100.0	2.2 ± 0.17	09.63
December	13	55.1 ± 2.0	4.92 ± 0.29	100.0	100.0	2.2 ± 0.17	09.12
January	14	54.5 ± 2.1	4.79 ± 0.29	100.0	100.0	2.3 ± 0.16	09.65
February	13	56.1 ± 2.6	5.08 ± 0.31	100.0	100.0	2.2 ± 0.15	10.87
March	14	57.1 ± 2.0	5.36 ± 0.20	100.0	100.0	2.2 ± 0.19	12.18
April	14	59.1 ± 2.1	5.46 ± 0.30	64.3	78.6	1.8 ± 0.30	13.62

[1] ± Standard error of the mean; [2] Score of 1-9 where 9 is the highest condition score.

Table 13. Reproductive performance of St. Croix ewes in St. Croix and in Utah.

	St. Croix (1987-1988)	Utah (1986-1987)	Utah (1986-1987)	Utah (1987-1988)
No. ewes	19	28	21	21
Age at lambing	2 years & older	2 years & older	1 year	2 years
Parturition date	4/3/88	4/8/87	5/8/87	4/10/88
Fertility (%)	94.7	89.3	95.2	100.0
Prolificacy (%)	194.0	220.0	130.0	176.0
Type of birth				
Singles (%)	16.7	8.0	70.0	23.8
Twins (%)	72.2	64.0	30.0	76.2
Triplets (%)	11.1	28.0	0.0	0.0
Fecundity (%)	184.0	188.0	130.0	171.0
Gestation length (days)	147.6 ± 0.61	146.7 ± 0.54	-	148.7 ± 0.33[1]
Weight lamb born per ewe lambing (kg)	5.2 ± 0.33	6.3 ± 0.45	4.1 ± 0.34	5.6 ± 0.26
Lamb survival				
Alive at birth (%)	94.3	85.4	100.0	97.3

[1]Gestation data available for 3 ewes.

Table 14. Body weight and body condition scores (Mean ± SEM) for St. Croix ewes in St. Croix and in Utah (1987-1988).

	St. Croix			Utah		
Year and month	No. ewes	Body weight (kg)	Body condition score[3]	No. ewes	Body weight (kg)	Body condition score
Sept., 1987	18	39.3 ± 1.5	5.4 ± 0.39	24	44.2 ± 1.6	4.4 ± 0.17
Oct., 1987	18	40.4 ± 1.5	4.3 ± 0.21	20	48.4 ± 1.2	5.1 ± 0.19
Nov., 1987	18	39.0 ± 1.5	3.7 ± 0.19	21	48.3 ± 1.6	4.7 ± 0.21
Dec., 1987	19	40.9 ± 1.8	3.9 ± 0.19	30	51.7 ± 1.5	4.6 ± 0.19
Jan., 1988	19	43.1 ± 1.6	4.1 ± 0.19	29	53.3 ± 1.4	4.9 ± 0.17
Feb., 1988	19	45.4 ± 1.9	4.7 ± 0.18	29	54.0 ± 1.4	4.8 ± 0.20
Mar., 1988	19	49.5 ± 1.9[1]	4.8 ± 0.19	-	-	-
Apr., 1988	19	42.5 ± 1.5[2]	2.8 ± 0.18	30	61.0 ± 1.7[1]	4.9 ± 0.19

[1]Prelambing; [2]Postlambing; [3]Score of 1-9 where 9 is the highest condition score.

Table 15. Body weight and body weight gains (Mean $\pm$ SEM) for St. Croix lambs in St. Croix and in Utah (1987-1988)[1].

		Two Week Intervals[2]					
	No. lambs	Birth	2	4	6	8	Birth to weaning
ST. CROIX:							
Body wt (kg)	32	2.9 ± 0.08	4.8 ± 0.16	7.0 ± 0.21	9.0 ± 0.29	10.8 ± 0.35	-
Average daily gain (kg)	32	-	0.14	0.15	0.15	0.13	0.14
UTAH:							
Body wt (kg)	39	3.2 ± 0.07	5.5 ± 0.22	9.0 ± 0.53	10.3 ± 0.54	12.2 ± 0.65	-
Average daily gain (kg)	39	-	0.16	0.25	0.10	0.13	0.16

[1]Weight at birth and at two weeks intervals following birth; [2]First weigh day that lambs were 7 or > days of age. Age varies at random, as much as $\pm$ 7 days of two week intervals for Utah and $\pm$ 3 days for the Virgin Islands. Values are unadjusted for sex or type of birth.

Virginia Polytechnic Institute & State University

1988 NC-111 Annual Report

OBJECTIVE 1. INCREASE PROLIFICACY AND EMBRYONIC SURVIVAL AND REDUCE SEASONALITY IN SHEEP

TITLE: Selection and Management Strategies to Reduce Seasonality of Breeding in Sheep

1. Objectives:

    a. Develop selected sheep populations with reduced seasonality of breeding

    b. Investigate management and environmental factors that contribute to reduced seasonality of breeding.

2. Experiment 1. Selection for aseasonality of breeding.

In fall, 1988, ewes were chosen at random from a pool of 225 ewes resulting from one or two generations of _inter se_ mating of three-way-cross ewes and rams and assigned to one of three lines. All ewes were 50% Dorset, 25% Rambouillet and 25% Finnsheep.

The Genetic Control (GC) line includes 45 ewes and 5 rams. These ewes will be bred for 45 d beginning October 1; first matings were in fall, 1987. Replacement ewes and rams will come from within the line. Replacement rates will be minimized to maximize generation interval and thereby minimize rates of drift and inbreeding. Each sire will be replaced with a son if possible.

GC ewes were 7 or 19 mo of age at the start of breeding, with corresponding mean weights of 37 and 56 kg and mean condition scores (scale of 1 to 9 with 9 fattest) of 4.3 and 4.9. In spring, 1988, 87% of the ewes lambed. Mean lambing rates for 2-yr-old ewes were 1.69 lambs born per ewe lambing, 1.57 lambs born per ewe exposed and 1.36 lambs weaned per ewe exposed. Comparable values for yearling ewes were 1.50 lambs born per ewe lambing, 1.30 lambs born per ewe exposed and 1.20 lambs weaned per ewe exposed. Lambs were weaned at an average age of 63 d. Mean scrotal circumference of male lambs was 13.3 cm.

The Selection (S) line includes 125 ewes and 10 rams. Ewes will be bred in single-sire pens for 60 d beginning May 1; first breeding was in May, 1988. Ewes will be pregnancy-tested via ultrasound in late July. If pregnancy rates are acceptable ($\geq$60%), there will be no clean-up breeding. If pregnancy rates are below 60%, a 30-d clean-up breeding using the same rams will begin on August 5. Replacement ewes will be chosen from those born to May-June matings. All ewe lambs will be exposed

to May-June breeding and pregnancy tested in late July to identify replacements. Supplementally, in year 1, first preference will be given to early-born lambs (first 14 d of lambing) whose dams presumably conceived without benefit of ram induction. Second preference will be given to lambs from yearling ewes. Final selections (if necessary) will favor lambs from multiple births. In subsequent years, performance indexes will be calculated for each ewe based on her performance relative to her contemporaries and selection will include complete relative information, selection of replacement rams will follow a similar procedure, but will include supplemental phenotypic selection for large scrotal circumference (minimum of 28 cm at 7 mo). Ideally, 30% of ewes and 50% of rams will be replaced each year. This will require a spring conception rate of about 50%. Minimum ewe replacement rate is anticipated to be about 15%.

The Environmental Control (EC) line is composed of 55 ewes and 5 rams maintained contemporary with the S line. Replacements for this line will come from the fall-mated GC line in order to avoid unintended selection within the line. As such, replacements for the EC line will uniformly be 6 mo older than those for the S line. Replacement rates in S and EC will be the same to equalize ewe and ram age distributions.

S and EC ewes were 1, 2, or 3 years old at breeding in spring, 1988. Mean weights were 57, 73 and 90 kg with a mean condition score of 5.5 for yearlings and 7.5 for older ewes.

3. Experiment 2: Effects of breed and time since lambing on spring estrous activity in mature ewes.

Frequencies of ovulation in mature nonlactating Dorset and Suffolk ewes were compared over a 21-d period beginning April 19. All Suffolk ewes (n = 23) had lambed the preceding winter (January); Dorset ewes had last lambed in either the preceding winter (n = 19) of the preceding fall (September and October; n = 39). Lambs were weaned in March for winter-lambing ewes or December for fall-lambing ewes. Ewes had been isolated from mature rams since the previous breeding and remained isolated during the 21-d experimental period. Ovulations were detected from twice-weekly determinations of circulating progesterone levels. The frequency of ovulation did not differ between winter-lambing Dorsets (21 ± 9%) and Suffolks (30 ± 10%) but was higher for fall-lambing Dorsets (59 ± 8%).

Following the initial experimental period, Dorset ewes were exposed to intact rams for 43 d. Biweekly progesterone determinations were continued for 14 d to detect ovulations that may not have been accompanied by estrus. Most Dorset ewes (93%) ovulated within 14 d of ram introduction. Previous lambing season (fall vs winter) did not affect frequency of ovulation or lambing, lambing date or number of lambs born. Ewes that ovulated during the period of ram isolation did not differ in overall lambing frequency (74% for both groups) but were more likely to conceive at the first ovulation following ram introduction (64 ± 10 vs 24 ± 9%), lambed earlier (October 5 ± 2.3 d vs October 12 ± 7.9 d) and had fewer

lambs born per ewe lambing (1.42 ± .13 vs 1.88 ± .11). Ewes that conceived at the first ovulation of the breeding season lambed 16.6 d earlier but had fewer lambs (1.12 vs 1.96 lambs/ewe lambing) regardless of whether or not the ewe ovulated during the period of ram isolation. These results suggest that exposure of ewes to vasectomized rams for 14 to 21 d before the start of breeding would be useful both to induce ovulation and to maximize subsequent lambing rates.

4. Experiment 3: Influence of continuous ram exposure on the mating behavior of yearling ewes in spring and early summer.

Four groups of ewes were used to study effects of continuous versus acute ram exposure on mating behavior in spring and early summer. The experimental period began on June 4 and terminated on July 30, or as soon thereafter as all ewes had exhibited two apparently normal estrous cycles. Three vasectomized rams equipped with marking harnesses were used to detect estrus. Ewes were checked twice weekly for evidence of mating, and jugular serum samples taken on days 0, 3 and 7 postmating were used to confirm the existence of a corpus luteum. Group 1 ewes (n = 18) had been continuously exposed to vasectomized rams since the previous October 16. Ewes in groups 2 (n = 19), 3 (n = 18) and 4 (n = 15) had been exposed to fertile rams from September 26 to December 1. Group 2 and 3 ewes lambed (mean lambing date of March 20). Group 2 ewes were placed with vasectomized rams as soon as they left the lambing barn (3 to 7 d postlambing); group 3 ewes were isolated from mature rams. Group 4 ewes did not lamb and were subsequently isolated from rams. Mean date of last estrus for group 1 ewes was February 22 ± 4 d. Mean postpartum interval to first estrus for group 2 ewes was 115 ± 7 d. The mean date of first mating for group 1 ewes was August 24 ± 7 d and the mean duration of anestrus was 183 ± 8 d. Group 2, 3 and 4 ewes had similar mean dates of first mating (July 20, 26 and 24 ± 6 d, respectively) and mated significantly sooner than group 1 ewes. Mating rates in a simulated spring breeding season of 35 d beginning June 4 were 0, 21, 39 and 40% (± 9%) for group 1, 2, 3 and 4 ewes, respectively. Thus, continuous ram exposure had a strong negative effect on mating rates in spring and early summer, and ewes exposed to rams immediately after lambing also tended to have lower subsequent mating rates.

5. Experiment 4: Performance of reciprocally transferred whitefaced crossbred ewes in Virginia and California.

A two-generation, 6-yr cooperative study between VPI&SU and the University of California-Davis was begun in spring, 1988. One hundred Dorset x Finn-Rambouillet ewes and 12 comparable rams from Virginia (VA ewes) and 100 Rambouillet x Finn-Dorset ewes with 12 comparable rams from California (CA ewes) are involved.

On April 7, 50 ewes and 6 rams were reciprocally transferred between locations with an additional 50 ewes and 6 rams retained as control flocks at each location. Ewes will be bred to rams of the same breeding at each location for 3 yr. Matings will occur from May 15 to July 1 with clean-up matings in August if needed following pregnancy test.

All ewe lambs will be retained and themselves evaluated for 3yr to separate effects of genetic origin and rearing environment. Ewes will again be mated to rams of the same breeding.

In Virginia, breeding this year began on May 18. One VA ram was removed from use following breeding soundness examination. CA ewes had average body weights of 54 kg for yearlings and 61 kg for older ewes with an overall mean condition score of 5.4 (scale of 1 to 9 with 9 fattest). VA ewes had average body weights of 56 kg for yearlings and 67 kg for older ewes with an overall mean condition score of 5.8.

6. Experiment 5: Effect of duration of ram isolation on spring mating behavior of whitefaced crossbred ewes.

Beginning December 3, 1987, 180 ewes from the S and EC lines (Experiment 1) were divided into 9 groups. Groups 1 and 2 were isolated from rams throughout winter and early spring. Groups 3 through 9 were initially placed with three vasectomized rams. Ewes were sequentially removed from ram exposure such that groups 3 through 9 received 9, 7.5, 6, 4.5, 3, 1.5 or 0 wk of ram isolation before the start of breeding on May 1. Ewes will be pregnancy tested in late July, 1988, and will lamb in October and November.

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UNIVERSITY OF WISCONSIN

1988 NC-111 Annual Report

Objective 1: Increase prolificacy and embryonic survival and reduce seasonality in sheep.

A. The Evaluation of Prolific Ewes Under Wisconsin Conditions (R. A. Kemp, J. J. Rutledge, Y. M. Berger, and L. D. Young)

A new research project has begun at the Spooner Agricultural Research Station to evaluate the productivity of Romanov-Targhee ewes and to compare them to Finnish Landrace-Targhee crossbred ewes in a terminal sire crossbreeding program. Production of crossbred ewes occurs at the station which also allows for a comparison of the productivity of Romanov-Targhee and Finnish Landrace-Targhee crossbred wethers. The goals of this study are:

1. To compare the survival, growth rate, age at puberty ovulation rate, conception rate, litter size and rebreeding performance of Romanov-Targhee and Finnish Landrace-Targhee ewes.

2. To compare the lifetime productivity and progeny performance of Romanov-Targhee and Finnish Landrace-Targhee ewes in a terminal crossbreeding program.

3. To compare the postweaning growth, feed efficiency and carcass merits of Romanov-Targhee and Finnish Landrace-Targhee wethers.

The first matings for the production of crossbred ewes occurred in September of 1987, with crossbred lambs being born in the Spring of 1988. The first group of crossbred wethers have been fed and carcass data collected in August 1988. Growth rate data is being collected on the crossbred ewe lambs and they are also being monitored for puberty using vasectomized rams. Puberty will be confirmed by progesterone assay of blood samples that are collected on a weekly basis from three months of age until puberty is observed. A total of three crops of crossbred Romanov-Targhee and Finnish Landrace-Targhee lambs, born in the Springs of 1988, 1989 and 1990 will be evaluated. Crossbred ewe lambs will be bred in the fall of 1988 and for subsequent years of the study, to terminal sires to produce commercial market lambs. Commercial market lambs (ewes and wethers) will be evaluated for lamb survival, pre- and post-weaning growth rate and carcass merit. A total of three crops of commercial market lambs, born in the Springs of 1989, 1990 and 1991 will be evaluated. This project is scheduled to continue until collection of carcass data on the final commercial market lambs in the Fall of 1991.

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UNIVERSITY OF WISCONSIN

1988 NC-111 Annual Report

Objective 1: Increase productivity and efficiency of reproduction and lamb survival in sheep.

A. The Evaluation of Romanov Sheep Under Wisconsin Conditions. D. L. Thomas, J. Rutledge, Y. M. Berger, and D. Thomas.

A new research project has begun at the Spooner Agricultural Research Station to evaluate the productivity of Romanov-Targhee ewes and to compare them to Finnish Landrace-Targhee crossbred ewes in an accelerated lambing program. Production of crossbred ewes occurs at the station which also allows for a comparison of the production of Romanov-Targhee and Finnish Landrace-Targhee crossbred wethers. The goals of this study are:

1. To compare the survival, growth rate, age at puberty, ovulation rate, conception rate, litter size and mothering performance of Romanov-Targhee and Finnish Landrace-Targhee ewes.

2. To compare the lifetime productivity and lambing performance of Romanov-Targhee and Finnish Landrace-Targhee ewes in an accelerated lambing program.

3. To compare the postweaning growth, feed efficiency and carcass traits of Romanov-Targhee and Finnish Landrace-Targhee wethers.

The first matings for the production of crossbred ewes occurred in September of 1987, with crossbred lambs being born in the Spring of 1988. The first group of crossbred wethers have been fed and carcass data collected in August 1988. Growth rate data is being collected on the crossbred ewe lambs and they are also being monitored for puberty using vasectomized rams. Puberty will be confirmed by progesterone assay of blood samples that are collected on a weekly basis from these females of age until puberty is observed. A total of three crops of crossbred Romanov-Targhee and Finnish Landrace-Targhee lambs, born in the Springs of 1988, 1989 and 1990 will be evaluated. Crossbred ewe lambs will be bred in the fall of 1988 and in subsequent years of the study, to terminal sires to produce commercial market lambs. Commercial market lambs (ewes and wethers) will be evaluated for lamb survival, pre- and post-weaning growth rate and carcass merit. A total of three crops of commercial market lambs, born in the Springs of 1989, 1990 and 1991 will be evaluated. This project is scheduled to continue until collection of carcass data on the third commercial market lambs in the Fall of 1991.